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Evaluation of Bonavista bean and fodder cowpea types under various seeding rates and their mixtures with Pearl millet

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B. Sc. Agric. Sci. Zagazig University (Benha branch), 2000

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1. INTRODUCTION

Among the national plans of increasing food and feed potentialities in Egypt is one that pays considerable attention for enhancing agricultural production and quality at reasonable alternative sustainable agronomic practices. In this regard, the severe lack of production of forage crops all year round especially during summer seasons where there is no available source of protein fodder plants to be grown. In other words, using fodder plants of high assimilation rates that provide higher yield and quality with minimum farming inputs is a must. Therefore, it is of great need to find out such plants from the indigenous native types which are adapted for the prevailing environmental conditions, where plant energy will be devoted for growth, yield and quality rather than for survival. Moreover, there are almost no certified commercial sources of forage seeds especially during summer season.

Among the available herbaceous forage legumes are Bonavista bean (*Dolichos lablab, L.*) and Fodder cowpea (*Vigna sinensis, L.*) of different types according to the color of their seed-coats. Moreover, mixtures of legumes and grasses (as pearl millet [(1)]) are expected to induce additive performance values in respect of nitrogen fixation and the extra other interacted beneficial advantages of such mixtures are of great concern to be studied.

The main target of this investigation is to evaluate the specific properties of growth behavior, forage yield and quality of some of the indigenous native herbaceous legumes as Bonavista bean and Fodder cowpea types in their pure stands and cropping patterns when intercropped with Pearl millet at 50:50% mixtures.

Moreover, as it is well known that plant population densities are considered among the limiting factors in creating more convenient microenvironment within plants canopies especially in dry hot summer seasons.

This study was designed and implemented for evaluating the behavior of some herbaceous indigenous-native legume of different types according to their different seed-coat colors planted at various seeding rates as well as finding out the extra magnified advantages of mixing with fodder pearl millet in another complementary experimental study.

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(1) Proved to be the most promissers forage grasses (among the study 4 forage grasses: Pearl millet, Sorghum hybrid, Sudan grass and Teosinte; M.Sc. Thesis; Saad, A.M., 2006

2. REVIEW OF LITERATURE

Biodiversity of different promising crops of high assimilation rates under the adverse environmental and edaphic conditions are of great concern. Presented review of literature could be classified under the following topics:

1- Behaviour of forage legumes types.

2-Plant population densities for enhancing the micro- environmental and edaphic conditions.

3- Mixing the studied forage legumes with pearl millet (as proved to be in earlier studies) for obtaining the benefits of mixing grasses and legumes.

1-Forage legumes

Mokoboki *et al.* (2000) clarified that there were significant varietal effects of cowpeas (*Vigna sinensis, L.*) on its chemical composition. Crude protein content is an important determinant of forage quality. Varieties TUV11424 and IT85D385 had crude protein contents of approximately 7 % on dry matter basis which is adequate to meet maintenance requirements of sheep and mature cattle. Variety significantly affected chemical characteristics of cowpea straw. Straw of varieties IT85D385 and TUV11424 would be valuable as supplements because they have relatively high crude protein content, low water retention, packed volume and retain more greenness at harvest. These varieties are likely to induce high intake and improve animal performance. Other varieties as IT1948-01F, IT93K1140 and IT87D697 are high in packed volume and water retention but both are so low in crude protein and greenness that make them of less value as supplements.

Jilani *et al.* (2001) determined forage yield and crude protein (CP) content in four legume species (cowpea, lablab bean (*Dolichos lablab, L.*), rice bean and sesbania) and sorghum as a reference crop. The highest dry weight of 4 t ha^{-1} was obtained from sesbania and sorghum and the lowest dry weight of 2 t ha^{-1} was produced from cowpea. Maximum and minimum heights of 144 and 86 cm were obtained from sesbania and rice bean plants, respectively, (cowpea 116 cm and lablab bean 89 cm). The highest fresh yield of 17 t ha^{-1} and the lowest of 9 t ha^{-1} was obtained from sorghum and lablab beans, respectively.The highest crude protein (CP) yield of 581 kg

ha^{-1} (16 %) followed by 533 kg ha^{-1} (20 %) and 532 kg ha^{-1} (19 %) then 415 kg ha^{-1} (21%) and 175 kg ha^{-1} (5 %) were recorded from sesbania, rice bean, lablab bean, cowpea and sorghum, respectively.

Jingura *et al.* (2001) reported that four legume species (*Lablab purpureus* cv. High Worth, *Macroptilium atropurpureum* cv. Siratro, *Stylosanthes guianensis* cv. Fine Stem and *Desmodium uncinatum* cv. Silver leaf) were grown in experimental plots on 4 soil types. The textural classes of the soils were sand, sandy loam, sandy clay loam and clay. Legume yield was not significantly affected ($P > 0.05$) by the type of soil. Lablab out-performed the other legumes with dry matter yield of 5.9 t/ha, compared with 3.1, 2.9 and 3.3 t ha^{-1} for Siratro, Fine stems and Silver leaf Desmodium, respectively. The corresponding protein concentrations in the legumes were 159,167, 159 and 134 g kg^{-1} DM. These results show that all these legumes can be grown satisfactorily in areas of high temperature and low rainfall and produce forage with a high crude protein concentration, while lablab produces the highest dry matter yield (DMY).

Quinn and Myers (2002) clarified that the extreme variability of the cowpea species, which has led to number of commercial cultivars are grouped by the variation in bean shape, size and color. In black-eyed or pink-eyed/purple hull peas, the seeds are white with a black eye round thorium. The "eye" can be other colors, pink, purple or shades of red are being common. Upon drying, the eye color darkens to a dark purple. The pods are purple-like on the pink-eyed/purple hull type. The seeds are not tightly packed or crowded in the pod and are kidney or oblong in shape. Whereas, brown-eyed peas-pods range in color, from green to lavender, and also in length. In Crowder pea, seeds are black, speckled, and brown or brown-eyed. The seeds are "crowded" in the pod and also tend to be globular in shape. Cream-seeds are cream colored and not crowded in the pods. So, this is an intermediate between black-eyed and Crowder types. White acre types-seeds are kidney shaped with a blunt end, semi-crowded and generally tan in color. Pods are stiff with small seeds. Clay type-seeds of older varieties are medium to dark brown in color and kidney shaped. Such forage cultivars-adapted for use as fodder or cover crop.

Odunsi (2003) determined the performance, nutrient digestibility of lablab (*Lablab purpureus*). He added that the constituent analysis showed that lablab contain 234.0 crude protein, 19.0 ether extract, 83.4 crude fiber, 116.0 ash and 467.0 g kg^{-1} nitrogen free extracts.

Ewansiha and Singh (2006) screened 72 accessions/varieties of relevant herbaceous legumes along with 3 cereals-millet, sorghum and maize for their relative drought tolerance. They classified 3 groups of fodder legumes according to their drought resistance degrees. Among the tested forages were lablab, horse gram, centrism and cowpea as a first group; chamaecrista and pearl millet as a second group; velvet bean, joint vetch, crotalaria, stylosanthes, sorghum and groundnut formed the third group, and blue pea and soybean as the most drought susceptible in the fourth group.

Ajeigbe et al. (2008) studied several cowpea varieties. They recorded seed coat colors of white, brown and black. Eight varieties had rough seed coat and one was smooth seeded. Significant differences were observed among such varieties for all the physical properties (100 seed weight, wet and dry seed volume, density, swelling and hardness). Authors concluded that crude protein content ranged from 21.3% in IT90K-76 to 26.5% in IT97K-1101-5. The highest protein content was found in IT97K-1101-5 (black seeded) and IT89KD-288 (white seeded) and the lowest of 21.3% in IT93K-452-1 (white seeded) and IT90K-76 (brown seeded) variety.

Foster *et al.* (2009) evaluated the productivity and nutritive value for soybean [*Glycine max (L.) Merr.*], cowpea [*Vigna unguiculata (L.) Walp.*], and pigeonpea [*Cajanus cajan (L.) Millsp.*]. At the recommended maturity stages for harvest as forage, soybean, and pigeonpea had greater ($P < 0.01$) herbage mass than cowpea. Leaf / stem ratio decreased with maturity and was greater for cowpea than for the other legumes from 10 through 14 weeks after planting (WAP). At the recommended maturity for harvest as forage, pigeonpea, soybean, and cowpea had crude protein (CP) concentrations of 121, 176, and 188 g kg^{-1}, respectively, neutral detergent fiber (NDF) concentrations of 695, 423, and 447 g kg^{-1}, respectively; and in vitro true dry matter digestibility of 351, 729, and 689 g kg^{-1}, respectively.

2-Plant population densities

Hintz *et al.* (1992) found that soybean [*Glycine max (L.) Merr.*] has a potential for use as an alternative forage crop; however, little is known about the effects of cultural practices on forage yield and quality of such crops. A study was conducted to evaluate the effects of cultivar, row spacing, plant density, and harvest maturity on the yield and quality of soybean forage. The cultivars Corsoy 79, Pella, and Williams 82 were grown at 20- and 76cm row spacing at planting rates of 280000and 890000 seeds ha^{-1}. The 20-cm row spacing produced more forage than the 76-cm row spacing, but crude protein concentration was 8 g kg^{-1} less.

Ball *et al.* (2000) evaluated plant population of soybean as a tool to manage crop growth, maximum biomass (BM), the time required for canopy closure, and yield. The time required after emergence to begin linear crop growth (t_b) was dependent on light interception (LI), and as density increased, linear crop growth decreased. The values of t_b varied from 16 to 27 d in 1997 and 22 to 37 d in 1998, with up to 12 difference in achieving >90% LI. They reported that slow crop growth could be minimized by using high populations in narrow rows. The authors indicate that higher populations than are traditionally recommended provide a way to optimize grain yields in time-constrained systems.

Meekins and McCarthy (2000) reported that Alliaria was grown at two densities (17 and 170 plants/m^2), three nutrient levels (no, low, or high nutrient addition) and three light levels (ambient sunlight and two shading treatments) to determine the effects of environmental heterogeneity on growth, reproduction and resource allocation in both mature and rosette plants. Overall, rosette growth and allocation patterns were significantly affected by all of the three tested variables. Low plant density, nutrient addition and high light availability resulted in plants with more leaves and greater dry weight biomass. Biomass allocation to shoots was greatest for plants in high-density and low-light treatments. Low density and high light availability resulted in significantly higher seed production. Plants in the lowest light treatment allocated significantly more biomass to shoot production and less to root production.

Shehu *et al.* (2001) evaluated the effects of plant population density (PPD) using rows at 70, 110 and 150 cm intervals on the yield and nutritive value of lablab, and the

effect of an interim harvest on response to PPD. Lablab yield ha^{-1} was increased to a greater extent by an increase in PPD from 110 to 70 cm interrow spacing than by an increase from 150 to 110 cm, and yield $plant^{-1}$ decreased as PPD increased to a greater extent for double-harvested than for single-harvested plants. This suggested that high PPD in the early stages of growth is important to promote high crop yields in this environment, probably because it mitigates drought effects in autumn. The effects of PPD on herbage composition were small and suggested that plant maturity had not been greatly affected by density. It is concluded that the maintenance of plant cover in the early stages of growth is important for high yields in the Savannah region, which can be achieved by an interrow spacing of no more than 70 cm and avoidance of an interim harvest.

Ali *et al.* (2001) evaluated the effect of different planting patterns and seed densities on the growth and yield performance of rice bean. Planting patterns were 60 cm apart single rows, 90 cm apart double row strips (30/90), 60 cm apart ridge sowing and 90 cm apart bed sowing with seeding densities of 20, 25 and 30 kg ha^{-1}. The different growth and yield parameters were significantly influenced by different planting patterns and seeding rates. The treatment combination of 25 kg ha^{-1} seeding under 60 cm ridge sowing produced the highest yield ha^{-1} and differed significantly from rest of all the other treatment combinations.

Quinn and Myers (2002) recommended seeding rate of 50 pounds per acre for cowpea. They added that plant populations in wide rows should be similar to soybeans, about 4 to 8 plants per foot of row. Field trials were done in Missourian 30 inch row spacing and the vine type varieties filled in the row well. The determinate, bush types may yield better on closer row spacing. Seed should be planted similar to soybeans at 1 to1.5 inches deep.

Valenzuela and Smith (2002) reported that the seeding rate of lablab was 70–120 lb pure live seed per acre by broadcast sowing, or 30–90 lb pure live seed per acre by drill sowing. The foliage has high protein content (15–30 %), with high levels of lysine and about 55% digestibility.

Twidwell *et al.* (2002) studied the effects of planting rate and row spacing on forage production of cowpeas. Their results indicated that forage yields of 50 and 100 pound

per acre seeding rates were almost similar, indicating no practical advantage to the higher seeding rate. Apparently, the bushy nature of the crop compensates for lower seeding rates, much like soybeans. Forage yields for cowpeas increased with decreased row-spacing, indicating superiority of narrow rows for forage production. The forage yield advantage of narrow rows may be due to less intra-row plant competition for water, nutrients, and solar radiation. Harvesting cowpeas at a later date will increase forage yield but decrease the quality of the forage. They also reported that cowpeas had high crude protein concentration and in vitro dry matter digestibility (IVDMD), and low levels of neutral detergent fiber (NDF) and acid detergent fiber (ADF).Cowpea forage in this study was comparable to alfalfa hay harvested at the late-vegetative to early-bloom stage.

Cameron (2003) recommended that lablab seed should be sown at 15-30 kg/ha into a well-prepared seedbed. Some crops have been sown at 40 kg/ha to get quick cover. Seed can be broadcasted or planted with combine in 20 or 40 cm rows. It can be successfully planted into a fairly rough seedbed, but results may vary. Seed can be inoculated with cowpea inoculums to ensure effective nodulation for nitrogen fixation, but this is not necessary if lablab or other legumes (cowpeas, mung beans, peanuts and styles) have been previously grown in the area to be used.

Nleya and Jeranyama (2005) reported that cowpea can be used for hay or silage. When used for hay, cut when most pods are fully formed. Dry matter yield ranged from 1.9 to 3.1 tons per acre in South Dakota when using seeding rate of 50-80 lb/A. Crude protein ranged from 19 to 24 % and ADF was 32 %.Meanwhile, **Miller *et al.* (2005)** suggested using row spacing from 6 to 12 inches for dry pea.

Hodgson and Blackman (2005) found that a reduction from a high (55–65 plants/m^2) to a low density (11-I2 plants/m^2) has little influence on the subsequent development of *Vicia faba* unless such thinning is delayed until the flowering phase. By this time, save for widely spaced plants, the level of self shading within the population has become marked. In fact, at high densities during the early-ripening phase, the light intensity at ground level may fall to 0.03 daylight while a considerable proportion of the plant up to 38 percent.-may receive less than 0.1 daylight. However, at low

densities the minimum intensity at ground level is 0.14 daylight and less than 3 percent, of the shoot is subjected to 0.1 daylight.

The above same authors reported that in pot experiments, using a range of screens, it was noticed that the compensation point is about 0.1 daylight. Thus, as the density is increased the light gradient between the apex and the base becomes progressively steeper and the proportion of the leaves not actively assimilating correspondingly greater.

El-Karamany (2006) studied the effect of three plant population densities (25, 43, 62 plants/m^2) of local mung bean variety (Kawmy-1). Results indicated that plant density 62 plants/m^2 produced the highest fresh forage yield with highest dry matter (%) and 25 plant/m^2 was the best in number of branches/plant and crude protein (%).

Schatz and Endres (2009) suggested that field peas should be seeded in narrow row spacing of 6 to 12 inches.

3-Mixing forage legumes with pearl millet

Abd El-Gawad *et al.* (1990) intercropped sordan with cowpea. Results showed that intercropping pattern 1: 2 revealed a significant increase with plant height than pure stand, whereas the pattern 2: 1 increased significantly each of number of branches than for pure stand. Intercropping significantly surpassed the measures of yield and yield components when compared with the relevant pure stand of cowpea.

In a similar study, **Abou Deya *et al.* (1990)** reported that 1 row of sordan to 2 rows of cowpea intercropping pattern produced the highest forage yield of sordan.

Also, **Mohanpillai *et al.* (1990)** indicated that intercropping of maize with cowpea significantly increased green fodder yield, dry matter and protein content than maize alone.

Singh and Ahuja (1990) found that sorghum yield increased appreciably due to legume association over sole legume. Maximum yield advantage obtained from cluster bean followed by cowpea. There is considerable advantage due to transfer of biological fixed nitrogen by the legumes (cowpea, cluster bean, soy bean and moth bean) to intercropped sorghum. So, this practice helps in reducing the dose of nitrogen fertilizer to sorghum.

Abd El –Aal *et al.* (1991) found that total fresh and dry yield fed^{-1} obtained from the grown mixtures were significantly higher than those obtained from guar and cowpea in their pure stands, but lower than those obtained from sweet sorghum and sordan 79 as sole cropping. The mixture of sordan 79 / guar produced the highest forage production compared to other tested mixtures. Mixtures between sweet sorghum and sordan 79 with guar or cowpea surpassed the grasses sole cropping in CP % and ash % and surpassed the legumes sole cropping in NFE %.However, CP % and EE% of the mixtures were lower than those of either grasses or legumes in sole cropping.

Odo (1991) studied physiological differences between crops in binary mixtures that can influence yield using short and tall sorghum varieties with cowpea. He found that the performance of the component crops depended largely on the relative proportion of cowpea and sorghum in mixtures. The system productivity index of mixtures where the proportion of sorghum: cowpea was 1: 3 showed that their yield stability was greater than that of the other tested sorghum – cowpea mixtures. Semilarly, **Abd EL-Gawad *et al.* (1992)** found that intercropping cowpea with Sudan grass at 1:3 pattern produced higher fresh and dry weights of relatively high quality forage yield compared with Sudan grass alone.

Also, **Nor El-Din *et al.* (1992)** in Egypt found that the highest fresh and dry yields were obtained with planting the mixture of 10 kg pearl millet plus 10 kg guar per feddan. Whereas, lowest yield was obtained when planting 20 kg of guar per feddan.

Sood and Sharma (1992) found that intercropping sorghum (Sorghum bicolor, L.) with legume significantly produced higher green and dry fodder yields than sorghum alone. The quality of the forage as indicated by higher crude protein and in vitro dry matter digestibility was also significantly better in sorghum + legume intercropping systems.

Mohamed (1992) clarified that intercropping patterns generally caused a significant increase in values of dry forage yield of cowpea, fresh and dry forage yield of Sudan grass, fresh and dry yield of the mixture, cowpea plant height at 2^{nd} and 3^{rd} cuts, stem diameter at 3^{rd} cut, leaf area / plant at 2^{nd} and 3^{rd} cuts, leaf / stem ratio at 3^{rd} cut, crude protein % at 2^{nd} and 3^{rd} cuts, total carbohydrates % at the three cuts, crude fiber % at the three cuts, and ash % at 1^{st} cut.Crude fiber was significantly increased when

cowpea intercropped with Sudan grass under different patterns.**Abd El-Gawad (1993)** showed a wide variation in relative dry yield of cowpea entries when associated with corn and sorghum.

Kerry and Robert (1994) conducted a field study where they intercropped a legume (cowpea, soybean or guar) and a nonlegume (pearl millet or amaranth). In the strip intercrops, only cowpea showed a consistent yield response to planting pattern, with the narrow strip arrangement than its monocrop in two environments. Land equivalent ratio of pearl millet grown in alternate rows with cowpea was not significantly different from their monocrops.

Saud and Thakuria (1994) studied the effect of a plant directed-seeded rice +fodder cowpea intercropping system on chemical properties of soil and crop productivity. Treatments (rice + cowpea in 1:1, 2:1, 3:1, 2:2, 3:2 and 3:3 row ratios along with sole crop of rice and cowpea) resulted in higher rice-grain equivalent yield compared with sole rice and cowpea indicating the benefit of intercropping system.

Sharma and Sharma (1994) reported that in semi-arid region 75 % of the recommended seed rate of pearl millet + 25 % of the recommended seed rate of each of green gram, cowpea and cluster bean gave higher economic return compared with sole pearl millet. Also, **Dubey *et al.* (1995)** proved that mixed cropping of soybean and pigeon pea with sorghum proved to be superior to sole cropping of sorghum equivalent yield. A long the same line, **Khistaria and Sadaria (1995)** found that the equivalent yield and net return of pearl millet were highest when it was intercropped with green gram (mung bean) compared with the other legume crops.

Yadav and Sharma (1995) noticed that sowing pearl millet and cowpea during summer, by mixing their seeds at 12 kg ha^{-1} and 20 kg ha^{-1}, respectively gave green forage yield of 55.1 ton ha^{-1} which was compared with what was obtained from sole crop of pearl millet. The quality of forage in the mixture was improved.

Sudhaker et al. (1996) results revealed that growing grasses with legumes as intercropped increased crude protein content compared to growing grasses as sole crop. Meanwhile, **Verma *et al.* (1997)** indicated that higher yield was obtained when intercropping sorghum and cowpea in mixture as compared to their relevant pure

stands. Crude protein yield and digestible dry matter yield were significantly higher in intercropping sorghum with cowpea.

Haggag (1998) found that intercropping pattern of 25 % cowpea : 75% sorghum gave the highest dry forage yield for each of cowpea and sorghum when compared with intercropping pattern of 2 : 2 (50 % cowpea : 50 % sorghum) and 3 : 1 (75 % cowpea : 25 % sorghum). Also, **Krishna *et al.* (1998)** found that intercropping maize and cowpea (30 + 60 cm) could produce 8.26 % higher crude protein. Meanwhile, **Gitonga *et al.* (1999)** indicated that green gram intercropped with maize was significantly higher in dry weights than ones grown in their pure stands. Green gram yield was not affected by maize intercrop; however, maize yields were significantly reduced by intercropping with green gram.

Shareif and Said (1999) revealed that the solid planting for both crops (sorghum and cowpea) exceeded all intercropping systems in forage yield in all cuts and total forage yield in both seasons. Intercropping cowpea with sorghum in alternate triple rows produced highest forage yield of cowpea during cuts and total forage compared with the other intercropping systems. Forage yield of both sorghum and cowpea increased significantly as the seeding rate proportion of sorghum and cowpea increased up to 20 kg sorghum + 35 kg cowpea fed^{-1}.

Abd El-Salam (2002) found that pearl millet and Sudan grass as sole crops outyielded all mixed cropping combinations with legumes. However, mixture treatments were more yielder than legumes as sole crops. Forage yields combinations of 2/3 cereals + 1/3 legumes outyielded other combinations of 1/2 +1/2 or 1/3 + 2/3. Growing legumes with cereal crops in mixtures could be recommended for improving the quality of cereals forage because are legumes characterized by higher crude protein, crude fat and ash contents as well as lower fiber content in comparison with cereals.

Zeidan *et al.* (2003) reported that mixture of fodder maize (100 % of planting density / fed.) on both sides of two ridges alternated with cowpea (50 % of planting density / fed.) on both sides of other two ridges gave higher fresh and dry forage yields compared with all of the other mixtures as well as fodder maize, cowpea and guar in their relevant pure stands. Concerning crude protein yield, cowpea solid planting gave the highest crude protein yield / fed. followed by the forage mixture of fodder maize

(75 % of planting density / fed.) + Cowpea (50 % of planting density / fed.) then the forage mixture of fodder maize (100 % of planting density / fed.) + Cowpea (50 % of planting density / fed.).

Singh *et al.* (2003) improved cropping systems for higher productivity and profitability with a minimum use of inputs, or in other words, using seeds of plants of higher assimilated rates that insured higher yield and quality with minimum farming inputs with its all practices. After evaluating several intercropping row arrangements on-station and in farmers' fields, they found that 2 cereal: 4 cowpea intercrop system gave100% to 300% gross economic superiority over the traditional intercropping systems. Small farmers prefer the improved practices because it provides them with sufficient sorghum and cowpea for home use and additional cowpea for cash income. Participatory on-farm evaluation of improved cowpea cultivars and improved cowpea-sorghum and cowpea-maize intercrop system has led to rapid farmer to-farmer diffusion and adoption of the new technology. From less than 50 farmers in 1998 more than 8000 farmers planted the improved cultivars and systems in 2002 in northern Nigeria.

Regarding lablab as a promissing proper forage crops, **Chambliss and Ezenwa (2006)** reported that Lablab or sweet hyacinth bean (Lablab purpureus L.) is a vigorous twining summer annual legume. Lablab cannot tolerate frost but grows well in a wide range of soils and pH (4.5 – 7.5), preferring well-drained soils or short periods of flooding. Whole forage samples of lablab may contain about 14%Crude protein with 64% digestibility. Leaves contain higher levels of crude protein (25%) and are more digestible than stems. Lablab grows well in mixtures with tall-growing grasses such as millet and forage sorghum.

Ibrahim *et al.* (2006) observed that the Effect of different combinations of maize and cowpea seeds in different proportions significantly affected the quantitative and qualitative characters of the fodder. The highest plant population (29.91/m^2) and plant height (227.8 cm) was noted in maize alone. The highest yield of green fodder (68.30 t ha^{-1}) and dry matter (13.26 t ha^{-1}) was obtained by sowing the crops in a seed ratio of 75:25 maize: cowpea. The maximum crude protein (18.10%) was produced by cowpea

sown alone and the minimum from maize plots sown alone (2.50%). The production of crude fiber was not influenced significantly by any of the seed proportions.

Mohammed *et al.* (2008) evaluated the growth and dry matter production of components of sorghum/cowpea intercrop at Kano, Nigeria. The treatments consisted of thirty cowpea genotypes differing in maturity periods and growth habits which were intercropped with local sorghum in 1:1 or single alternate row arrangement. Results revealed that plant height and dry matter of sorghum was not affected by cowpea genotype. The early maturing genotypes had narrower canopy spread (65-97 cm) than the medium and late maturing genotypes having the widest width (165 cm). Plant height of cowpea was not affected by cowpea genotypes. Medium maturing genotypes recorded the highest dry matter.

Results of **Armstrong and Albrecht (2008)** experiment do not show benefit to addition of lablab bean into high producing corn stands. Corn sown at a density of 80,000 plants ha^{-1} in its pure stand is recommended to maximize forage DM yield and crop value. Alternatively, addition of lablab bean into low density corn stands did increase CP concentration and feed nutrient value of the forage.

Along the same line, **Armstrong *et al.* (2008)** found that intercropping corn (*Zea mays* L.) with climbing beans is a viable option to increase crude protein (CP) concentration in forage rather than purchasing high-cost protein supplements for livestock rations. Corn was intercropped with three forage beans-lablab bean [*Lablab purpureus* (L.) Sweet], velvet bean [*Mucuna pruriens* (L.) D.C.], and scarlet runner bean (*Phaseolus coccineus* L.). Their experiments show that lablab bean grown with corn has the greatest potential of the three beans to increase CP concentration above monoculture corn

Geren *et al.* (2008) evaluated corn (*Zea mays indendata*) mixed with legumes such as various cowpea (Vigna unguiculata) and bean (Phaseolus vulgaris) cultivars monocropped or intercropped in same or alternate-rows. Results indicated that intercropping system increased many characteristics such as plant height, fresh biomass and dry matter (DM) yield and crude protein (CP) content. Intercropped corn with legumes was far more effective than monocropped corn to produce higher DM yield.

Abou Keriasha *et al.* (2009) studied the response of three cowpea varieties (Cream-7, Dokki-331 and Kaha-1) intercropped with maize under different densities in relation to yield and yield components of both crops. They found that yield components characters of cowpea were increased with decrease of its intercropping density.

Dahmardeh *et al.* (2009) found that intercropped maize and bean in different planting ratio (100:100, 50:100, 100:50, 25:75, 75:25, 50:50, 0:100 and 100:0) significantly affected the quantitative and qualitative characters of the forage. The highest yield of fresh fodder (65.7 t ha^{-1}) was obtained by sowing the crops in ratio of 100:100. The highest crude protein (19.65 %) was produced by the cowpea sole cropping and the lowest from the maize plots sole cropping (12.11 %).

3. MATERIALS AND METHODS

Six field experiments were carried out at the Experimental Research Center, Faculty of Agriculture, Moshtohor, Benha University, Kalubia Governorate during two summer growing seasons (2007 and 2008) to investigate **forage potentiality assessment of some Egyptian indigenous-native legumes** in three different complementary studies which were:

I-The first study

Bonavista bean type performance

The target of this study is to determine the best Bonavista bean types as a forage leguminous crop in respect of productivity and quality (at three plant population densities). Treatments were as follows:

A- Bonavista bean types

1-Bonavista bean (*Dolichos lablab, L.*) of White seed-coat.

2-Bonavista bean (*Dolichos lablab, L.*) of Black seed-coat.

3-Bonavista bean (*Dolichos lablab, L.*) of Brown seed-coat.

Seeds of each of the three summer forage legumes were brought from indigenous-native regions of Upper Egypt (Aswan).

B- Seeding rates

Three plant population densities of the assigned seeding rates 10, 20 and 30 kg/feddan. The experimental unit area of each -sub plot was 10.5 m^2 (3 x 3.5 meter) with an area of about 1/400 per fed. Seeds in the assigned seeding rates (10, 20 and 30 kg/fed.) for each treatment were adjusted per experimental unit and distributed evenly Approved recommended agronomic practices of growing forage legumes were applied properly.

This study included 9 treatments which were the combinations of 3 forage legumes (Bonavista bean types) x 3 seeding rates. Experimental lay out was split- plot design in 4 randomized blocks in each of the two seasons. The leguminous forage types were distributed randomly in the main plots, whereas the three seeding rates were assigned randomly in the sub plots.

II- The second study

Fodder cowpea type performance

The target of this study is to evaluate the specific properties (growth rate, forage yield and quality) of some fodder cowpea as indigenous-native legumes of Egypt at three plant population densities. The treatments were as follows:

A- Fodder cowpea types

1-Cowpea (*Vigna sinensis, L.*) of Creamy seed-coat.

2-Cowpea (*Vigna sinensis, L.*) of Brown seed-coat.

3-Cowpea (*Vigna sinensis, L.*) of Dotted seed-coat.

Seeds of each of the three summer forage legumes were brought from indigenous-native regions of Upper Egypt (Aswan).

B- Seeding rates

Three different seeding rates were 15, 30 and 45 kg/feddan. The experimental unit area of each -sub plot was 10.5 m^2 (3 x 3.5 m) with an area of about 1/400 per fed. Seeds in the assigned seeding rates (15, 30 and 45 kg/fed.) for each treatment were adjusted per experimental unit and distributed evenly. The other recommended agronomic practices of growing forage legumes were applied properly.

The experiment included 9 treatments which were the combinations of 3 forage legumes (Fodder cowpea types) x 3 seeding rates. Experimental lay out was split- plot design in 4 randomized blocks in each of the two seasons. The leguminous forage types were distributed randomly in the main plots, whereas the three plant population densities were assigned randomly in the sub plots.

III- The third complementary study

Mixing the studied forage legumes with pearl millet

The aim of this investigation is to study the potentiality response of each of the studied 6 forage legumes (3 Bonavista bean and 3 Fodder cowpea types) with pearl millet as proved to be a favorite fodder grass in their pure stands and relevant mixtures. Experiment included 13 treatments in 4 replications which were presented in Table (1).

The ultimate target of these investigations is to introduce, evaluate and select among the native indigenous plant materials of the best forage behavior and characteristics in respect of production and quality. This is to achieve the advantages of the biological biodiversity and their tolerance to the prevailing adverse environmental conditions. Under appropriate agronomic practices.

For the complementary study, investigations were devoted to compare the production and feeding value of each of the six forage legumes (3 Bonavista bean types and 3 Fodder cowpea types) in their monoculture as well as their potentialities if mixed with pearl millet as super selected fodder grass in 50:50 % ratio*.

Such a study was designed to find out the extra added values of mixing legumes and grasses on forage yield and quality of the previously tested native indigenous legumes in the first and second study.

Each of the same forage legumes previously mentioned in the first and second study were intercropped with pearl millet and their relevant pure stands as well, using appropriate cultural practices of better management for these commonly grown forages. The proposed selected pearl millet, proved to be superior in production and quality as compared with the other evaluated forage grasses in M.Sc. study previously conducted under the same experimental station of faculty of Agriculture, Benha University **(Saad, A.M., 2006).**

The experimental design was layed out in a complete randomized block design (CRBD) with four replicates in each of the two seasons. The pure and mixtures forages were distributed randomly in blocks, each experimental unit was 10.5 m^2 (3 x 3.5 m) of about 1/400 feddan area.

Phosphorus fertilizer was applied in form of calcium super phosphate (15.5% P_2O_5) at a rate of 150 kg/feddan during the appropriate soil preparation and before sowing.

Magnesium fertilizer was applied in form of magnesium sulfate (20% Mg) at a rate of

* The experiment included 13 treatments in four replicates using CRBD complete randomized block design as presented in Table (1).

Table (1): Studied leguminous forages at their proposed seeding rates and their pure stands, or mixtures.

NO.	Treatments		Seeding rate (kg / fed)
Pure stands:			
1	Pearl millet	(PM)	20
2	White Bonavista bean	(WB)	20
3	Black Bonavista bean	(BB)	20
4	Brown Bonavista bean	(BRB)	20
5	Creamy Fodder cow pea	(CFC)	30
6	Brown Fodder cow pea	(BRFC)	30
7	Dotted Fodder cow pea	(DFC)	30
Relevant mixtures (50:50 %):			
8	Pearl millet + White Bonavista bean	(PM +WB)	10+10
9	Pearl millet + Black Bonavista bean	(PM + BB)	10+10
10	Pearl millet + Brown Bonavista bean	(PM + BRB)	10+10
11	Pearl millet + Creamy Fodder cow pea	(PM + CFC)	10+15
12	Pearl millet + Brown Fodder cow pea	(PM + BRFC)	10+15
13	Pearl millet + Dotted Fodder cow pea	(PM + DFC)	10+15

20 kg/feddan splitted in two doses after sowing and after the first cut as abase treatment. The recommended seeding rate for each of the above forage crops was followed in the assigned mixture with a ratio of 50%: 50 % .Seeds which was sown on June, 1st of 2007and 2008 summer seasons.

Two cuts were obtained for each study of the two growing seasons. The first cut was obtained at 60 days from sowing and the second cut was obtained 40 days from the first cut.

The soil type of the experimental unit is clay with pH 7.8. The physical and chemical properties of the experimental soil units of Moshtohor Exp. Station are recorded in Table (2-a) in each of the two growing summer seasons.

Studied parameters:

Climatic factors during each of the two growing seasons of the experiments (Table 2-b) were supplied from the Climates Research Station, Agriculture Research Center.

Table (2-a): Physical and chemical properties of the experimental soil units at Moshtohor agric. Exp. Station in the two growing seasons.

Properties	Seasons	
	2007	2008
<u>Mechanical analysis</u>		
Course sand %	4.84	5.44
Find sand %	12.03	18.36
Silt %	30.56	26.24
Clay %	52.30	49.96
Texture grade	Clay	Clay
<u>Chemical analysis</u>		
pH (1: 2.5)	7.8	7.6
E.C. (ds/m) (1:20)	0.18	2.0
O.M (%)	1.91	1.93
$CaCO_3$ (%)	2.3	3.30
HCO_3 (meq/L)	1.25	1.25
Cl^- (meq/L)	0.57	0.61
Ca^{++} (meq/L)	0.9	0.9
Na^+ (meq/L)	0.81	0.77
K^+ (meq/L)	0.16	0.21
Mg^{++} (meq/L)	0.23	0.28
N available (mg/kg)	**195**	**255**
P available (mg/kg)	**11**	**8**
K available (mg/kg)	**1170**	**1450**

Table (2-b): Prevailing ambient temperature at Kalubia Governorate during each of the two growing seasons.

Climatic factors	Temperature (°C)			
Season / Month	First season		Second season	
	Max	Min	Max	Min
1-15 June	32.40	20.33	34.73	21.93
16-30 June	35.20	23.13	36.53	22.93
1-15 July	33.66	22.93	34.60	23.73
16-31 July	33.62	23.75	36.00	24.56
1-15 August	32.90	23.46	34.75	22.80
16-31 August	34.56	24.00	35.41	22.37
1-15 September	32.26	22.20	34.21	21.93
16-30 September	32.66	20.60	34.54	20.69

A-Vegetative growth characteristics: Ten plants were randomly selected from each experimental unit in each of the two growing seasons for studying the following parameters:

-Plant height (cm).

-Stem diameter per plant (cm) was measured at the far bottom of the stems right after cut using regular caliber.

-Leaf area per plant (cm^2) was measured using electronic planemeter (CI 202 AREA METER, manufactured by CID, Inc., U.S.A.).

-Leaf / stem ratio was estimated on fresh weight basis.

-Number of shoots/m^2, an extra parameter was added in the third complementary study.

- Light intensity effect (Lux)

Light intensity meter (Digital Illumination meter- Lux / Foot-Candle- INS- DX-200) was used for two plants heights. Those are at the far top of the plants estimating the prevailing ambient intercepted light immetion intensity. Meanwhile, another reading

was recorded at soil surface. Reading was taken in luxces unit (F.C=10.7 lux). This to determine the differences of light intensities as an approximate indicator for the intensity of plant population of the assigned treatments (plant population density / m^2).

B- Fresh and dry forage yield

Fresh forage yield of the grown forage crop plants under study was determined for each of the subsequent cuts in each experimental unit for each of the two studied seasons and recorded in ton / feddan using field scale of 0.5 kg sensitivity, then forage yield was estimated and recorded in ton / fed.

Dry forage yield productivity was estimated as follows: samples of about 200 gm of fresh forage were selected randomly from each experimental unit just before accurately weighted using an electric balance of 0.01 gm sensitivity. Such obtained fresh samples were dried in an air forced drying oven at 105°C for 3 hours till constant weight to determine the dry matter content. Then, dry yield was estimated accordingly.

C- Chemical analysis

Samples of the proposed treatments were prepared to be analyzed for each of the two cuts (on dry matter basis) for each treatment of the two replicates in each of the two growing seasons in the three studies under investigation. This is to represent the general effect of the imposed treatments. In other words, such two cuts were taken for each of the two seasons of each of the three studies.

Chemical analysis was conducted and presented on dry matter basis. Fresh forage samples were randomly taken (through quadrate of ¼ sq meters) from each experimental unit. Accurately weighed samples of the fresh forage of about 200 gm were dried using an air forced drying oven at 75°C till a constant weight. Samples were dried in a labeled Kraft paper bags which were laid in air forced drying oven all over the drying period. Dried samples were then cooled at room temperature, ground finely and screened through using hummer mill of 40 michs. The screened fine grounded samples were kept in sealed labeled plastic bags and stored in the refrigerator at 5°C till needed for the chemical analysis.

Dried samples of each two replicates for each treatment were mixed thoroughly to form two composite samples out of the 4 replicates. Out of each of the two composite samples, two analysis were done for each treatment, the average results of each analysis in study were recorded.

The conducted chemical analysis of forage quality components included the following:

1-Crude protein (CP) content

Total nitrogen percentage was determined according to the modified micro kjeldahl method. Crude protein content was estimated by multiplying nitrogen percentage by 6.25 **(A.O.A.C., 1990)**.

2-Crude fiber (CF) content

Crude fiber percentage was determined according to the **A.O.A.C. (1990).**

3-Ash content

Accurate weight of 2 g of the dried composite samples (which were re-dried) for each treatment were put in weighted labeled-crucibles and placed in a muffle furnace at 600°C for about 6 hours, then cooled down to room temperature and weighted till constant weight **(A.O.A.C., 1990).**

4-Ether extract (EE) content

Ether extract content was extracted using petroleum ether (40-60°C boiling point) in a soxhlet apparatus provided with cold water condenser for 9 hours at a rate of 6 siphons/hour **(A.O.A.C., 1990).**

5-Nitrogen free extract (NFE) content

It was estimated by subtracting the sum of the percentages of crude protein, crude fiber, ash and ether extract out of 100.

[NFE % = 100 – (CP% + CF% + EE% + Ash %)]

6-Total digestible nutrients (TDN)

The TDN of the forages was calculated according to **Adams *et al.* (1964)** equations as follows:

[TDN % for grasses = 50.41 + 1.04 CP % – 0.07 CF %]

[TDN % for legumes = 74.43 + 0.35 CP % – 0.73 CF %]

[TDN % for mixtures = 65.41+ 0.45 CP – 0.38 CF %]

7- Digestible Protein (DP) content

The digestible Protein (DP) of the forages was calculated according to **Bredon *et al.*, (1963)**: **DP % = 0.9596 CP – 3.55.**

Statistical analysis

Each of the three experiments previously presented was statistically analyzed individually according to the presented design for each of the two growing seasons (2007, 2008).This in addition to combined analysis of the two seasons. The analysis of variance was carried out according to the procedure described by **Steel and Torrie (1981).** L.S.D. test at 5% level was used to compare between means.

4. RESULTS AND DISCUSSION

Results and discussion will handle the impact of each of the studied factors under study and their interactions on the behaviors, performance and potentialities of the parameters under study in a chronological order. Combined analysis of the two growing seasons was used to identify the general comprehensive impact of the imposed individual factors and their interactions in general within seasons and for cutting sequence. Studied parameters will be presented and also discussed under the following topics:

A-Forage yield productivity

A-1. Fresh forage yield

Bonavista Bean Types

Results in Table (3) represent fresh forage yield of the selective studied indigenous-native legumes plants at various seeding rates for each of the obtained cuts of two growing seasons and their combined analysis.

Over the applied seeding rates, results of the combined analysis indicate significant differences in total fresh forage yield among the studied Bonavista bean types. The White type was of the highest significant total fresh forage production (22.25 ton/fed), whereas, Brown and Black Bonavista bean types produced almost similar fresh forage yield which was 19.03 and 19.06 ton /fed, respectively. So, the White type of B.bean was of about 17% higher in fresh forage yield as compared with the other two types (Brown and Black).

Also, there was a slight difference between total fresh forage productivity of the three B. bean types within each of the two summer seasons. The White, Brown and Black types produced 21.33, 18.34 and 17.36 ton/fed, respectively with no significant differences during the first summer season. Whereas, during the second season White, Black and Brown types produced forage yield of 23.17, 20.76 and 19.73 ton /fed., respectively with significant differences of various magnitudes.

Such obtained differences were noticed among each of the two seasons where the forage productively in generally was relatively higher in the second than the first season. These variations could be due to the slight effect of the different ambient temperature during the two subsequent seasons as presented in Table (2-b). This result could give a signal of heat simulation of vegetative growth for such grown B.bean types. Such obtained result are along the same line as those of **Shehu *et al.* (2001)**, **Valenzuela and Smith (2002)**, **Cameron (2003)**, **Ewansiha and Singh *et al.*(2006)** in Bonavista bean and **El Karamany (2006)** in mung bean

From the combined analysis, White type of B. Bean was almost similar in fresh forage yield (ton /fed) of each of the obtained cuts, whereas, the other two types (Black and Brown) were slightly higher in forage yield for the second than the first cuts with almost similar magnitudes (Table 3).

Over the grown forage legumes, the combined analysis clarified that total forage yield of each Bonavista bean types substantially increased as seeding rates increased with significant differences of different magnitudes. As seeding rates increased from 10 to 20 and up to 30 kg /fed, total fresh forage yield was substantially increased with a respective production of 17.49, 20.38 and 22.47 ton/fed.

It looks to be true that the total increase in forage yield due to increasing seeding rate (from 10 to 20 and 30) was more pronounced in subsequent magnitudes during the second than the first season. This could be due to creating better and soft microenvironment within the plant canopies whenever the intensity of plantation increase per unit area of land by the increase in seeding rates during the excessive worm weather as the summer season proceeds (Table 2-b).

Combined analysis also revealed significant differences in forage yield production between the White, Black and Brown Bonavista bean types within cuts (Table3). Along the whole used seeding rates, total yield of the second cuts were higher than that of the first cuts, with more yield as seeding rates increased with significant differences. The trend of the individual cuts for each B. bean types and the applied

seeding rates were more or less similar to the seasonal total fresh forage yield and the combined analysis as it is clear from Table (3).

The interaction effect of B. bean types and seeding rates on fresh forage yield was only significant for total fresh forage yield and the first cut of the second season as well as for the first cut of the combined analysis of the two seasons. However, results generally indicate that the highest fresh forage yield was obtained from White B. bean types when planted at the highest seeding rates (30kg/fed). Meanwhile, the lowest forage yield was obtained from Brown Bonavista bean type, planted at the lowest seeding rate (10kg/fed). But, it could be generally concluded that White type of Bonavista bean was the best selected type in forage production as compared with the other two types (Black and Brown), where they did not exert appreciable significant difference in between.

Also, the population densities per unit area of land for the highest seeding rate could be advisable for producing higher fresh forage yield, since the larger number of plants per unit area of land help plant to shade each other and keep reasonable moisture in between and cutting down the evaporation rates and reducing the soil temperature and finally encouraging the well needed soil microflora that keeps the soil alive for the well known physiobiological activities.

It could be more likely true that the stored energy of growth and production will be saved rather than using such energy in survival and existence of plant under the harsh hot dry and adverse environmental and edaphic conditions which used to be at the lightest planting population densities when using lower seeding rates.

Fodder Cowpea Types

Over the applied seeding rates, results of the combined analysis indicate significant differences among the studied fresh fodder cowpea types (Table 3). The Creamy type was of the highest forage production (19.88 ton / fed). However, Creamy and Dotted fodder cowpea produced almost similar forage yield which was 19.88 and 19.49 ton / fed., respectively. Whereas, Brown fodder cowpeas type was of the lowest significant

fresh forage production (18.17 ton / fed), which was of about 9% lower in forage yield as compared with each of the other two fodder cowpea types.

It is also clear that there was a slight difference between total fresh forage yield of the three fodder cowpea types within each of the two summer seasons. Creamy, Dotted and Brown types produced total fresh yield of 18.60, 17.43 and 16.43 ton/fed., respectively with significant differences during the first summer season. Whereas, during the second season Dotted, Creamy and Brown types produced forage yield of 21.53, 21.17 and 19.90 ton / fed., respectively with no significant differences in between. Such obtained differences were noticed among the two seasons where the forage productivity in general was relatively higher in the second than the first season. These variations could be due to the effect of the different ambient temperature during the two subsequent seasons as presented in Table (2-b).

Combined analysis data indicated that Dotted type of fodder cowpea was almost the highest in fresh forage productivity in the first cut, Meanwhile, Creamy type was the highest fresh yield in the second cut. It is generally noticed that fresh forage yield was higher for the first than the second cuts with slight different magnitudes (Table 3).In this respect other previous comparative studies for other forage legumes types and cultivars were reported previously by other researchers as **Mokoboki *et al.* (2000), Quinn and Myers (2002), Ewansiha and Singh *et al.*(2006)** and **Ajeibe et al.(2008)** in fodder cowpea.

Over the grown indigenous fodder cowpeas, the combined analysis clarified that total fresh forage yield of each of the grown fodder cowpea types substantially increased as seeding rates increased with significant differences of various magnitudes. Total forage yield was significantly increased with a respective production of 17.67, 19.17 and 20.70 ton / fed. as seeding rates increased from 15 to 30 and up to 45 kg/fed.

It looks to be true that the total increase in forage yield due to increasing population density of plants/ unit area of land by increasing seeding rate from 15 to 30 and up to 45was more pronounced during the second than the first season. This is, as previously

mentioned, could be due to creating better soft microenvironment within plant canopies whenever the intensity of plantation increased.

Combined analysis generally revealed significant differences in fresh forage yield production between the creamy, Brown and Dotted fodder cowpea types within cuts (Table 3). Over the used seeding rates, total fresh yield of the first cuts was higher than that of the second cuts, with higher yield as seeding rates increased significantly (Table3).Similar results were reported by **Hintz *et al.* (1992)** in soybean, **Ali *et al.*(2001)** in rice bean and **Twidwell *et al.*(2002)** in fodder cowpea.

The trend of the individual cuts for each of grown fodder cowpea types and the applied seeding rates were more or less similar to the seasonal total fresh forage yield and the combined analysis as it is clear from Table (3).

The interaction effect of fodder cowpea types and seeding rates on fresh forage yield was only significant for the second cut of the first season and the first cut of the combined analysis of the two seasons. However, results generally indicate that the highest forage yield was obtained for Creamy fodder cowpea when planted at the highest seeding rate (45 kg / fed). Meanwhile, the lowest fresh forage yield was obtained from Brown fodder cowpea, planted at the lowest seeding rate (15kg/ fed). Whereas, it could be generally concluded that Creamy type of fodder cowpea was the superior type in fresh forage production as compared with the other two types (Brown and Dotted) where they did not exert significant differences in between.

Also, the thinner population densities of fodder cowpea plants for the highest seeding rate per fed. could be advisable for producing highest fresh forage production. However, according to the obtained results in this study it is favorable to increase plant population densities in a relative ratio for increasing fresh forage production of Fodder cowpeas. Such results could be for different variety of reasons where plants shade each other and creating soft microenvironmental conditions between plant canopies as well as cutting down the evaporation rates, reducing the soil temperature by plants canopy-cover. Moreover, encouraging the well needed useful soil microflora

Table (3): Fresh yield productivity of the studied forage legumes at various seeding rates.

Types (T)	Density (D) kg / fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1^{st} cut	2^{nd} cut	Total	1^{st} cut	2^{nd} cut	Total	1^{st} cut	2^{nd} cut	Total
Bonavista bean performance:					……… (ton / fed.) ………					
White	10	9.60	9.60	19.20	10.20	9.50	19.70	9.90	9.55	19.45
	20	10.50	10.50	21.0	12.50	11.20	23.70	11.5	10.85	22.35
	30	11.50	12.30	23.80	13.60	12.50	26.10	12.55	12.40	24.95
Mean		10.53	10.80	21.33	12.10	11.07	23.17	11.32	10.93	22.25
Black	10	5.50	7.70	13.20	9.30	9.90	19.20	7.40	8.80	16.20
	20	9.0	9.70	18.70	9.90	10.80	20.70	9.45	10.25	19.70
	30	9.30	10.90	20.20	10.30	12.10	22.40	9.80	11.50	21.30
Mean		7.93	9.43	17.36	9.83	10.93	20.76	8.88	10.18	19.06
Brown	10	7.20	8.70	15.90	8.40	9.40	17.80	7.80	9.05	16.85
	20	8.30	10.20	18.50	9.40	10.30	19.70	8.85	10.25	19.10
	30	9.90	10.70	20.60	10.20	11.50	21.70	10.05	11.10	21.15
Mean		8.47	9.87	18.34	9.33	10.40	19.73	8.90	10.13	19.03
10		7.43	8.67	16.10	9.30	9.60	18.90	8.36	9.13	17.49
20		9.27	10.13	19.40	10.60	10.77	21.37	9.93	10.45	20.38
30		10.23	11.30	21.53	11.37	12.03	23.40	10.80	11.67	22.47
Mean		8.98	10.03	19.01	10.42	10.80	21.22	9.70	10.42	20.12
L.S.D at: 5% for :		T = 1.87, D = 1.11	T= 1.09, D= 1.67	D= 1.97,	T=1.63, D=0. 6, TD=1.046	D = 0.59	T= 1.57, D= 0.82, TD= 1.42	T= 1.10, D=0.61, TDY=1.49	T= .67, D= 0.60	T= 1.12, D= 0.90
Fodder cowpea performance:										
Creamy	15	12.20	5.80	18.0	13.30	5.90	19.20	12.75	5.85	18.60
	30	12.50	5.50	18.0	14.10	6.80	20.90	13.30	6.15	19.45
	45	13.40	6.40	19.80	15.80	7.60	23.40	14.6	7.0	21.60
Mean		12.70	5.90	18.60	14.40	6.77	21.17	13.55	6.33	19.88
Brown	15	10.40	4.40	14.80	12.70	5.10	17.80	11.55	4.75	16.30
	30	11.50	5.30	16.80	14.60	5.50	20.10	13.05	5.40	18.45
	45	12.30	5.40	17.70	15.40	6.40	21.80	13.85	5.90	19.75
Mean		11.40	5.03	16.43	14.23	5.67	19.90	12.82	5.35	18.17
Dotted	15	11.10	4.90	16.0	14.70	5.50	20.20	12.90	5.20	18.10
	30	12.30	5.20	17.50	15.70	6.0	21.70	14.0	5.60	19.60
	45	12.60	6.20	18.80	16.20	6.50	22.70	14.40	6.35	20.75
Mean		12.0	5.43	17.43	15.53	6.0	21.53	13.77	5.72	19.49
15		11.23	5.03	16.26	13.57	5.50	19.07	12.40	5.27	17.67
30		12.10	5.33	17.43	14.80	6.10	20.90	13.45	5.72	19.17
45		12.77	6.0	18.77	15.80	6.83	22.63	14.28	6.42	20.70
Mean		12.03	5.45	17.48	14.72	6.14	20.86	13.37	5.80	19.17
L.S.D at: 5% for :		D = 0.88	T = 0.53 , D = 0.31, TD = 0.55	T= 1.43, D= 1.02	D = 1.09	T = 0.85, D = 0.39	D= 1.07	D= 0.68	T= 0.45, D= .24, TDY= 0.60	T= 0.94, D= 0.71

which keeps the soil alive for various essential soil microflora and biological activities and improving soil physical, chemical and nutritional condition. Rhyzobial symbiotic bacteria in legumes will satisfy adequate amounts of nitrogen

from the ambient air for free will be of great advantage in saving the required mineral nitrogen fertilization. In addition to the prevailing reducing or eliminating weed infestation. All of these vast advantages will stimulate growth and production of the indigenous native legumes especially in arid hot desert areas in sustainable organic clean agronomic practices where the competion for the essential plant requirements will be in favour of the grown plants rather than weeds. Such presented benefits will be the corner stone of the required biological and organic farming.

A-2. Dry forage yield

Data in Table (4) represent dry forage yield of the studied indigenous- native forage legumes at various seeding rates for the obtained cuts of the two growing seasons and their combined analysis as well.

Bonavista Bean Types

Combined analysis (over the applied seeding rates) clarified appreciable significant differences in total dry forage yield among the studied Bonavista bean types with variable significant magnitudes. Total dry forage yield productivity could be ranked in the following descending order: White > Black> Brown B. bean types. The respective total dry forage yield was 3.62, 3.04 and 1.03 ton/fed. The White type was about 28% higher in dry forage yield as compared with the other two types (Black and Brown).

It is obviously clear that there were slight differences between the obtained dry yield of the three B. bean types within each of the two summer seasons. The White, Black and Brown, Bonavista bean types produced 3.63, 2.98 and 2.86 ton /fed in the first season, being 3.60, 310 and 2.78 ton /fed in the second season with significant differences (Table 4).

It should be pointed out that the highest productive dry forage was the White type whereas, the lowest one was the Brown type, with a respective significant differences of 27% and 30% in the first and second summer seasons.

The combined analysis showed that the White type of B. bean was almost similar in dry forage productivity for each of the obtained two cuts. Whereas, the other two types (Black and Brown) were slightly higher in dry yield for the second than the first cuts with almost similar magnitudes (Table 4) which was 1.33 and 1.23 ton/fed in the first cut and 1.71 and 1.60 ton/fed in the second cut , respectively.

The obtained differences in dry forage yield for each of the grown indigenous native Bonavista bean types (White, Black and Brown) were off course due to their individual specific genetical make up that interact differently with the prevailing environmental conditions of their seed production under their native growing conditions of far-upper Egypt (Aswan) and under the circumstances of this study in specific patterns (Table 2). These results confirm what were reported by **Mokoboki *et al.* (2000)** in fodder cowpea and **Jingura *et al.* (2001)** in lablab.

Regarding the impact of seeding rates, combined analysis over legumes indicated that the obtained total dry yield of each of the grown Bonavista bean types substantially increased as seeding rates increased significantly. As seeding rates increased from 10 to 20 and up to 30 kg /fed, total dry yield was significantly increased with a respective production of 2.81, 3.25 and 3.47 ton /fed.

It seems to be true that the total increase in dry fodder yield of Bonavista bean due to increasing seeding rate (from 10 to 20 and 30 kg /fed) was more clear in both seasons. These results are along the same line as those of **Nleya and Jeranyama (2005)** and **Miller *et al.* (2005)** in fodder cowpea. Such result could be due to creating soft microenvironment within plant canopies when using higher seeding rates.

Combined analysis also revealed significant differences in total dry yield of production between White, Black and Brown Bonavista bean types within cuts (Table 4). Over the used seeding rates, total dry forage yield of the second cuts were higher

than the first cuts, with higher yield as seeding rates increased with significant differences.

It is generally noticed that total dry forage yield was increased as the seeding rates increased from 10 up to 30 kg/fed. with significant higher magnitudes for the earliest than the latest cuts with 26 and 22 %, respectively.

The trend of the individual cuts for each of grown B. bean types and the applied seeding rates were more or less similar to the seasonal total fresh forage yield and the combined analysis (Table 4) as presented and discussed earlier.

The interaction effect of B. bean types and their seeding rates for dry forage yield was not significant for the individual cuts of the two seasons or their combined analysis as well (Table 4).

However, results evedentiate that highest dry forage yield was obtained for White B. bean when planted at the highest seeding rate (30kg /fed). Meanwhile, the lowest dry yield was obtained from the Black Bonavista bean type, planted at the lowest seeding rate (10kg/fed.). In other words, it could be generally concluded that White type of Bonavista bean was the best selected type in dry forage production as compared with the other two types (Black and Brown Bonavista bean) where they did not exert significant difference in between.

Also, the highest population densities between plants for the highest seeding rate (30kg/fed.) could be advisable for producing higher dry forage yield (3.47 ton/fed).

Since the larger number of plants per unit area of land help plants to shade each other and keep reasonable moisture in between and cutting down the evaporation rates, reducing the soil temperature and finally encouranging the well need soil microflora that keeps the soil alive especially in dry hot conditions.

So, such results were discussed earlier. in addition the accumulated energy could be used for growth and production rather than for the survival of plants when using the lighter seeding rates and suffering heat and dryness. This result was true for the

individual cuts of each of the two seasons and the combined analysis as well with relatively various magnitudes.

Fodder Cowpea Types

Over the applied seeding rates, combined analysis (Table 4), showed no significant differences in dry forage yield between the studied fodder cowpea types. However, Dotted and Creamy fodder cowpea types produced almost similar dry forage yield which was 2.85 and 2.83 ton/fed, respectively. Whereas, Brown type was of slightly lowest dry forage production (2.68 ton/fed). Moreover, the Dotted type was of about 6% higher in dry matter yield as compared with the other two types of fodder cowpeas (Creamy and Brown). These results were not the same in fresh forage yield previously presented and discussed.

It is obviously clear from Table (4) that Creamy, Dotted and Brown types produced 2.91, 2.72 and 2.58 ton/fed., respectively with significant differences during the first season. Whereas, during the second season Dotted, Brown and Creamy types It should be pointed out that the total increase in dry matter yield due to increasing seeding rates (from 15 to 30 and 45) was more pronounced during the second than the first season. **El Karamany (2006)** in local mung bean reported similar results.

The combined analysis revealed significant differences in the obtained dry yield production between Creamy, Brown and Dotted fodder cowpea types within cuts (Table 4). Over the tried seeding rates, total dry forage yield of the first cuts was higher than of the second cuts, producing higher yield as seeding rates increased with significant differences.

The trend of the individual cuts for each of grown fodder cowpea types and the applied seeding rates were more or less similar to the seasonal total fresh forage yield and the combined analysis as it is clear from Table (4).

The interaction effect of fodder cowpea types and seeding rates for dry forage yield was only significant for the total and the second cut of the combined analysis of the two seasons. But, results show that the highest dry forage yield was obtained from

Table (4): Dry yield productivity of the studied forage legumes at various seeding rates.

Types (T)	Density (D) kg / fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Total	1st cut	2nd cut	Total	1st cut	2nd cut	Total
Bonavista bean performance:				... (ton / fed.) ...						
White	10	1.45	1.94	3.39	1.57	1.51	3.08	1.51	1.73	3.24
	20	1.66	1.94	3.60	1.80	1.88	3.68	1.73	1.91	3.64
	30	1.77	2.15	3.92	1.95	2.10	4.05	1.86	2.13	3.99
Mean		1.62	2.01	3.63	1.77	1.83	3.60	1.70	1.92	3.62
Black	10	0.96	1.34	2.30	1.18	1.53	2.71	1.07	1.43	2.50
	20	1.45	1.86	3.31	1.55	1.78	3.33	1.56	1.82	3.38
	30	1.43	1.90	3.33	1.42	1.84	3.26	1.43	1.87	3.30
Mean		1.28	1.70	2.98	1.38	1.72	3.10	1.33	1.71	3.04
Brown	10	1.11	1.45	2.56	1.09	1.45	2.54	1.10	1.45	2.55
	20	1.17	1.68	2.85	1.25	1.49	2.74	1.21	1.58	2.79
	30	1.43	1.76	3.19	1.30	1.76	3.06	1.36	1.77	3.13
Mean		1.23	1.63	2.86	1.21	1.57	2.78	1.23	1.60	2.83
10		1.17	1.58	2.75	1.28	1.50	2.78	1.23	1.58	2.81
20		1.43	1.82	3.25	1.53	1.72	3.25	1.48	1.77	3.25
30		1.54	1.94	3.48	1.56	1.91	3.47	1.55	1.92	3.47
Mean		1.38	1.78	3.16	1.46	1.71	3.17	1.42	1.76	3.18
L.S.D at: 5% for :		T= 0.31, D= 0.20	T= 0.23, D= 0.24	T= 0.26, D= 0.34	T= 0.17, D= 0.12	T= 0.19, D= 0.14	T= 0.22, D= 0.19	T= 0.16, D= 0.11	T= 0.13, D= 0.13	D= 0.19
Fodder cowpea performance:										
Creamy	15	1.68	1.14	2.82	1.66	0.78	2.44	1.67	0.96	2.63
	30	1.66	1.11	2.77	1.80	0.89	2.69	1.73	1.0	2.73
	45	1.93	1.19	3.12	2.11	1.00	3.11	2.02	1.09	3.11
Mean		1.76	1.15	2.91	1.86	0.89	2.75	1.81	1.02	2.83
Brown	15	1.50	0.81	2.31	1.78	0.73	2.51	1.64	0.77	3.41
	30	1.62	0.95	2.57	2.05	0.76	2.81	1.84	0.86	2.70
	45	1.76	1.09	2.85	2.21	0.85	3.06	1.99	0.97	2.96
Mean		1.63	0.95	2.58	2.02	0.78	2.80	1.82	0.86	2.68
Dotted	15	1.53	0.99	2.52	1.98	0.81	2.79	1.75	0.90	2.65
	30	1.68	1.07	2.75	2.22	0.63	2.85	1.95	0.85	2.80
	45	1.71	1.17	2.88	2.38	0.91	3.29	2.05	1.04	3.09
Mean		1.64	1.08	2.72	2.19	0.79	2.98	1.92	0.93	2.85
15		1.57	0.98	2.55	1.81	0.77	2.58	1.69	0.88	2.57
30		1.65	1.04	2.69	2.02	0.79	2.78	1.84	0.90	2.74
45		1.80	1.15	2.95	2.24	0.92	3.16	2.02	1.03	3.05
Mean		1.67	1.06	2.73	2.02	0.82	2.84	1.85	0.94	2.79
L.S.D at: 5% for :		D= 0.14	T= 0.13, D= 0.09	T= 0.19, D= 0.19	D= 0.23	D= 0.08	D= 0.22	T= 0.18, D= 0.14	T= 3.11, D= 0.06, TDY= 0.14	TY= 0.23, D= 0.14

Dotted fodder cowpea when planted at the highest seeding rates(45 kg/fed). Meanwhile, lowest dry forage yield was obtained from Brown type of fodder cowpea planted at the thinner plant population densities (15 kg/fed). However, it could generally be concluded that the Dotted fodder cowpea type was the best in dry forage production as compared with the other tested two types (Creamy and Brown), where they did not exert significant differences in between.

B- Vegetative growth characteristics

B-1. Plant height

Data in Table (5) represent plant heights of the selective studied indigenous-native legumes plants at various seeding rates for the obtained cuts of two growing seasons and their combined analysis as well.

Bonavista Bean Types

Over the applied seeding rates, combined analysis clarified appreciable significant differences in plant heights among the studied Bonavista bean types with variable significant magnitudes. Plant height could be ranked in the following descending order: Black then White followed by Brown Bonavista bean types where the respective plant heights were 165.15, 109.87 and 91.03 cm. Black type was of about 81.4% taller in plant height as compared with the other two types (White and Brown).

It seems to be true that there was appreciable significant differences between the obtained plant heights of the three B. bean types within each of the two summer seasons. The Black, White and Brown B. bean types were of 172.54, 121.93 and 96.90 cm height in the first season and of 157.75, 97.78 and 85.18 cm.in the second season, respectively.

It should be pointed out that the tallest plants were of Black Bonavista bean type, whereas, the lowest ones were of the Brown type with a respective significant differences of 78 % and 85 % in the first and second seasons (Table 5).

The combined analysis showed that Black type of Bonavista bean was almost similar in plant heights for each of the obtained cuts, whereas, the other two types (White and Brown) were slightly taller for the first than the second cuts (Table 5).

It looks to be true that, the obtained differences in plant heights for each of the Black, White and Brown Bonavista bean types were refered to their individual specific genetical makeup as affected by the prevailing environmental conditions under the circumstances of this study in specific patterns (Table 2-b). Similar results were reported by **Mokoboki *et al.* (2000)** in Bonavista bean.

The combined analysis (over the grown forage legumes) indicated that the obtained plant heights of each of the grown Bonavista bean types substantially decreased as seeding rates increased significantly. As seeding rates increased from 10 to 20 and up to 30 kg /fed, plant heights significantly decreased with a respective plant heights of 140.44, 122.70 and 102.91 cm.

The obtained decrease in heights of plants as a result of increasing plant population densities by the relative increase of seeding rate may be due to the convenient microenvironmental conditions within plant canopies, which in turn produced healthier leafy plants with shorter internodes. This is in addition to obtained more branching. In other words plants in convenient microenvironment used to store its energy in growth and development rather than expending its energy in survival mechanisms to cope with the harsh environmental condition of plants suffering stresses of the adverse environmental conditions especially during hot dry summer seasons.

Such a result may be explained by the subjected stress of the microenvironmental factors around the far-away plants which led plants energy for survival with longer internodes rather than building heavy, thick and healthy vegetative growth in respect of higher leaf / stem ratio with more branches if planted closer under more favorable environmental and edaphic conditions.

It may be more likely true that the stored energy of growth and production under favorable microenvironmental condition would be saved for better vegetative growth rather than using such energy in survival and existence of plant under the harsh hot dry environmental conditions which used at the lightest planting population densities when using lower seeding rates.

The combined analysis also revealed significant differences in plant heights between Black, White and Brown Bonavista bean types within cuts (Table5). The tallest plants were noticed for the Black type (165.15 cm), whereas, the shortest plants were recorded for Brown type (91.03 cm) with significant differences of 38 % and 36 % in the respective two cuts (Table 5).

The interaction effect of Bonavista bean types and their seeding rates for plant height was only significant for the individual cuts of the two seasons or their combined analysis (Table 5). However, results exerted that tallest plants were obtained for Black Bonavista bean type when planted at the thinner seeding rates (10kg/fed). Meanwhile, the shortest plant heights were obtained from Brown Bonavista bean type, planted at the highest seeding rate (30kg/fed).

Fodder Cowpea Types

Over the applied seeding rates, the combined analysis (Table 5) showed no significant differences in plant heights between the studied fodder cowpea types(Table 5). The Creamy fodder cowpea type was of the tallest plants (79.87cm), whereas, the Brown and Dotted fodder cowpea produced almost similar plant height which were 75.88 and 74.92 cm, respectively. The Creamy type was of about round to 7 % taller as compared with the other two types.

It is obviously clear that there was a slight difference with no significant magnitudes between plant heights of the three fodder cowpea types in the first season. Meanwhile, they exerted slight significant differences during the second season. Plant height could be ranked in the following descending order: Creamy (76.86 cm) then Dotted (75.11 cm) followed by Brown (72.60 cm) during the first season. Corresponding to Creamy

(82.87 cm) then Brown (79.16 cm) followed by Dotted (74.74 cm) during the second season with slight significant differences.

Such obtained differences were noticed between the two seasons where plant heights in generally were relatively taller in the second than the first season. These variations could be due to the slight higher temperature during the second season than the first one as presented in Table (2-b).

It should be pointed out that from the plant heights of the combined analysis, the Creamy type of fodder cowpea was almost the tallest during the two cuts as compared with the other two types. Also, it seems to be true that plant heights were tallest during the first than the second cuts with different magnitudes(Table 5). These results match with those of **Mokoboki *et al.* (2000)** in fodder cowpea.

The combined analysis Over fodder cowpeas revealed that plant height of each of the grown fodder cowpea types substantially decreased as seeding rates increased with significant differences of various magnitudes. As seeding rates increased from 15 to 30 and up to 45 kg/fed. Plant heights were substantially decreased with significant differences with a respective heights of 80.88, 77.27 and 72.52 cm.

It looks to be true that, the total decrease in plant heights due to increasing seeding rate from (15 to 30 and 45) was more pronounced during the second than the first season. This as previously mentioned could be due to creating better soft microenvironment within plant canopies, whenever the intensity of plantation increased by the extra increase in seeding rates especially at the relatively more high temperature of the second season (Table 2-b).

The combined analysis revealed significant differences in plant heights between the creamy, Brown and Dotted fodder cowpea types within each of the two cuts. Over the applied seeding rates, plant heights of the first cuts were taller than for the second cuts, with shorter heights as seeding rates increased with significant differences (Table 5).

Table (5): Plant height of the studied forage legumes at various seeding rates.

Types (T)	Density (D) kg / fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Bonavista bean performance:					.... (Cm)					
White	10	135.0	120.10	127.55	116.75	86.37	101.56	125.88	103.24	114.56
	20	136.25	116.50	126.37	114.25	80.40	97.32	125.25	98.45	111.85
	30	110.25	113.48	111.86	113.0	76.10	94.55	111.63	94.79	103.21
Mean		127.17	116.69	121.93	114.66	80.91	97.78	120.92	98.82	109.82
Black	10	215.75	200.0	207.87	218.75	177.0	197.88	217.25	188.50	102.88
	20	196.0	145.32	170.66	161.75	171.75	166.75	178.88	158.54	168.71
	30	142.25	135.95	139.10	132.25	85.0	108.63	137.26	110.48	123.86
Mean		184.67	160.42	172.54	170.92	144.58	157.75	177.79	152.50	165.15
Brown	10	115.0	111.77	113.38	97.25	91.57	94.41	106.13	101.68	103.90
	20	82.75	90.45	86.60	82.75	94.20	88.47	82.75	92.33	87.54
	30	73.0	108.40	90.70	79.25	66.0	72.63	76.13	87.20	81.66
Mean		90.25	103.54	96.90	86.42	83.93	85.18	88.33	93.73	91.03
10		155.25	143.96	149.60	144.25	118.32	131.28	149.75	131.14	140.44
20		138.33	117.43	127.88	119.58	115.45	117.51	128.96	116.44	122.70
30		108.50	119.28	113.89	108.17	75.70	91.93	108.33	96.49	102.91
Mean		134.03	126.89	130.45	124.0	103.15	113.57	129.01	115.02	122.02
L.S.D at: 5% for :		T= 23.27, D= 15.14, TD=26.22	T= 6.96, D= 14.18, TD=26.23	T= 12.97, D= 11.03, TD=19.11	T= 18.24, D= 11.19, TD= 19.38	T= 24.62, D=19.36, TD=33.53	T= 17.12, D= 11.90, TD=20.62	D= 9.10, TD=15.76	T= 11.38, D= 11.60, TD=16.40, DY= 20.08	T= 9.48, D= 7.84, TD= 13.58
Fodder cowpea performance:										
Creamy	15	107.0	53.82	80.41	124.25	62.91	93.58	115.63	58.37	87.0
	30	96.75	55.60	76.17	105.0	58.33	81.66	100.88	56.96	78.92
	45	95.0	53.0	74.0	89.75	57.0	73.37	92.48	55.0	73.69
Mean		99.58	54.14	76.86	106.33	59.41	82.87	102.96	56.78	79.87
Brown	15	98.75	49.28	74.02	100.25	62.75	81.50	99.50	56.01	77.76
	30	92.75	49.72	71.24	99.75	58.50	79.12	96.25	54.11	75.18
	45	90.0	55.10	72.55	97.50	56.20	76.85	93.75	55.65	74.70
Mean		93.83	51.37	72.60	99.17	59.15	79.16	96.50	55.26	75.88
Dotted	15	98.25	55.40	76.83	96.0	61.90	78.95	97.13	58.65	77.89
	30	97.25	59.75	78.50	94.75	59.07	76.91	96.0	59.41	77.71
	45	90.0	49.98	69.99	84.75	51.95	68.35	87.38	50.96	69.17
Mean		95.17	55.04	75.11	91.83	57.64	74.74	93.50	56.34	74.92
15		101.33	52.83	77.08	106.83	62.52	84.67	104.08	57.68	80.88
30		95.58	55.03	75.31	99.83	58.63	79.23	97.71	56.83	77.27
45		91.67	52.69	72.18	90.67	55.05	72.86	91.17	53.87	72.52
Mean		96.19	53.52	74.86	99.11	58.73	78.92	97.65	56.13	76.89
L.S.D at: 5% for :		N.S	N.S	N.S	T= 4.66, D= 9.19	N.S	T= 5.28, D= 5.01	T= 4.77, D= 6.85	N.S	D= 3.92

The interaction effect of fodder cowpea types and their seeding rates on plant heights were not significant for the two seasons or for their combined analysis of the two seasons. However, results generally indicate that the tallest plant heights were obtained for Creamy fodder cowpea type when planted at the lowest seeding rate (15 kg / fed). Meanwhile, the shortest plant heights were obtained from Dotted fodder cowpea, planted at the heaviest seeding rate (45kg/ fed).

Whereas, it could be generally concluded that Creamy type of fodder cowpea was the superior type in plant heights as compared with the other two types (Brown and Dotted), where they did not exert significant differences in between. Also, the thinner

Population densities of fodder cowpea types when using the lowest seeding rate per fed. may be the reason for producing tallest plant.

B-2. Stem diameter

Results in Table (6) present stem diameters of the selective studied indigenous-native leguminous plants at various seeding rates for the obtained cuts of the two growing seasons and their combined analysis.

Bonavista Bean Type

Combined analysis (over the applied seeding rates) evidentiated there was a slight significant differences in stem diameter among the studied Bonavista bean types. The Black and the Brown B.bean types were of similar stem diameter which was 0.91cm. Meanwhile, the White Bonavista bean type was of the thinnest stem diameter (0.81 cm). Brown and Black types were of about 12.3 % thicker in stem diameter as compared with the other type of Bonavista bean (White type).

It looks to be true that there was appreciable significant differences between the obtained stem diameter of the three B. bean types during the second season. Stem diameter could be ranked in the following descending order: Brown (0.85 cm),Black (0.79 cm) and White (0.77 cm) in the first season, and being Black (1.02 cm), Brown (0.97 cm) and White (0.84 cm) in the second season. Moreover, Such obtained

differences were also noticed between the two seasons where stem diameters were generally relatively higher in the second season than the first season (Table 6).

The combined analysis clarified that Brown type of Bonavista bean was almost similar in stem diameter for each of the obtained cuts, whereas, the other two types (White and Black) were slightly higher in stem diameter for the second than the first cuts (Table 6).

It looks to be true that, the obtained differences in stem diameters for each of the Brown, Black and White Bonavista bean types were off course due to their individual specific genetical makeup that interact differently with the prevailing environmental conditions under the circumstances of this study (Table 2-b).

The combined analysis (over legumes) indicated that the obtained stem diameter of each of the grown Bonavista bean types substantially decreased as seeding rätes increased significantly. As seeding rates increased from 10 to 20 and up to 30 kg /fed, stem diameter was significantly decreased with a respective stem diameters of 1.09, 0.86 and 0.67 cm.

It looks to be true that the decrease in stem diameter due to increasing seeding rate (from 10 to 20 and 30 kg/fed.) was more clear in both seasons.

Combined analysis also exerted significant differences in stem diameter between the Brown, Black, and White Bonavista bean types within cuts (Table 6). Over the used seeding rates, stem diameter of the second cuts were thicker than that of the first ones, with slightly thinner stem diameter as seeding rates increased with significant differences.

It seems to be true that the largest stem diameter of plant was for the Brown type (0.91cm), whereas the lowest was for White type (0.81 cm) with significant differences of 46 % and 80 % in the respective two cuts as compared with the highest and lowest seeding rates (Table 6).

The interaction effect of Bonavista bean types and their seeding rates for stem diameters of their plants was significant for the individual cuts of the two seasons or

their combined analysis (Table 6). However, results evidentiate that largest stem diameters were obtained for Black B. bean type when planted at the lighter seeding rates (10kg/fed). Meanwhile, the lowest stem diameter was obtained from Black Bonavista bean type planted at the highest seeding rate (30kg/fed).

Also, the lowest population densities per unit area of land for the lowest seeding rate (10 kg/fed.) may be the reason for producing higher stem diameter due to larger distance between plants which tended to form more vegetative growth per plant that was reflected in fresh and dry forage yield of plants.

Fodder Cowpea Types

Over the applied seeding rates, data for the combined analysis (Table 6) showed no significant differences in stem diameters between the studied fodder cowpea types (Table 6). It should be pointed out that results did not show significant differences between the obtained stem diameters between the three fodder cowpea types for each of the two seasons.

Stem diameter ranked in the following descending order: Dotted (0.55cm),Brown (0.55cm) and Creamy (0.53cm) in the first season and being Creamy (0.65cm), Brown (0.62cm) and Dotted (0.60cm) in the second season with no significant differences in both of the two seasons. Such obtained differences were observed between the two seasons where stem diameters generally were relatively higher in the second than the first season (Table 6).

It is obviously clear that the combined analysis showed no significant differences in stem diameters between fodder cowpea types during each of the obtained cuts.

The combined analysis over fodder cowpeas indicated that the obtained stem diameter of each of the grown fodder cowpea types substantially decreased as seeding rates increased significantly. As seeding rates increased from 15 to 30 and up to 45 kg/fed. Stem diameters substantially decreased with a respective stem diameter of 0.67, 0.57 and 0.52 cm.The decrease in stem diameters due to increasing seeding rate from (15 to 30 and 45) was more pronounced in both of the two seasons.

Table (6):Stem diameter per plant of the studied forage legumes at various seeding rates.

Types (T)	Density (D) kg / fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Bonavista bean performance:				..........(Cm)..........						
White	10	0.88	0.90	0.89	1.10	0.93	1.01	0.99	0.91	0.95
	20	0.71	0.88	0.79	0.9	0.83	0.86	0.80	0.86	0.83
	30	0.60	0.66	0.63	0.67	0.64	0.65	0.64	0.65	0.64
Mean		0.73	0.81	0.77	0.89	0.80	.84·	.81·	0.81	0.81
Black	10	0.78	1.05	0.91	1.33	1.83	1.53	1.06	1.44	1.25
	20	0.86	0.85	0.85	0.80	0.85	0.82	0.83	0.85	0.84
	30	0.66	0.50	0.58	0.75	0.60	0.67	0.71	0.55	0.63
Mean		0.77	0.80	0.79	0.96	1.09	1.02	0.87	0.95	0.91
Brown	10	0.75	1.17	0.96	1.23	1.15	1.19	0.99	1.16	1.07
	20	0.71	1.02	0.86	1.10	0.83	0.96	0.91	0.92	0.91
	30	.68·	0.80	0.74	0.80	0.74	0.77	0.74	0.77	0.75
Mean		0.71	0.99	0.85	1.04	0.90	0.97	0.88	0.95	0.91
10		0.80	1.04	0.92	1.22	1.30	1.26	1.01	1.17	1.09
20		0.76	0.92	0.84	0.93	0.83	0.88	0.85	0.88	0.86
30		0.65	0.65	0.65	0.74	0.66	0.70	0.69	0.65	0.67
Mean		0.74	0.87	0.80	1.03	0.93	0.95	0.85	0.90	0.87
L.S.D at: 5% for :		D= 0.1	T= 0.08, D= 0.09	D= 0.06	T= 0.05, D= 0.08, TD= 0.14	T= 0.05, D= 0.13, TD= 0.22	T= 0.04, D= 0.08, TD= 0.14	D= 0.06, TY= 0.1, DY= 0.09, TDY= 0.15	T= 0.04, D= 0.08, TY= 0.06, TD= 0.13, DY= 0.11, TDY= 0.18	T= 0.04, D= 0.05, TY= 0.06, TD= 0.09, DY= 0.07, TDY= 0.12
Fodder cowpea performance:										
Creamy	15	0.66	0.54	0.60	0.80	0.70	0.75	0.73	0.62	0.67
	30	0.53	0.54	0.53	0.66	0.65	0.65	0.59	0.59	0.59
	45	0.52	0.43	0.48	0.56	0.54	0.55	0.54	0.48	0.51
Mean		0.56	0.50	0.53	0.67	0.63	0.65	0.56	0.56	0.59
Brown	15	0.65	.61·	0.63	0.77	0.68	0.73	0.71	0.65	0.68
	30	0.56	0.51	0.53	0.66	0.57	0.61	0.61	0.54	0.57
	45	0.55	0.44	0.50	0.53	0.52	0.52	0.54	0.48	0.51
Mean		0.58	0.52	.55·	0.65	0.59	0.62	0.62	0.56	0.59
Dotted	15	0.69	0.55	0.62	0.69	0.67	0.68	0.69	0.61	0.65
	30	0.50	0.53	0.52	0.53	0.63	0.58	0.52	0.58	0.55
	45	0.59	0.49	0.54	0.52	0.57	0.54	0.55	0.53	0.54
Mean		0.59	0.52	0.55	0.58	0.62	0.60	0.59	0.57	0.58
15		0.67	0.56	0.61	0.75	0.68	0.71	0.71	0.62	0.67
30		0.53	0.52	0.52	0.62	0.61	0.61	0.57	0.57	0.57
45		0.55	0.59	0.57	0.54	0.54	0.54	0.54	0.50	0.52
Mean		0.58	0.56	0.57	0.64	0.61	0.62	0.61	0.56	0.59
L.S.D at: 5% for :		D= 0.08	N.S	D= 0.07	D= 0.07	D= 0.05	D= 0.03	D= 0.05	D= 0.05	D= 0.04

In this respect, the lowest seeding rates resulted in about 29 % higher stem diameters as compared with the other two seeding rates (30 and 45 kg/fed.). Also, the combined analysis evidenced significant differences in stem diameters between the Creamy, Brown and Dotted fodder cowpea types within each of the two cuts. Over the used seeding rates, stem diameters of the first cuts were slightly higher than the second cuts, with lower stem diameter as seeding rates increased with significant differences. In addition, highest stem diameter of plants was for the Creamy type (0.67cm). Whereas, the lowest stem diameter was for the Dotted type (0.52cm) with significant differences of 31 % and 24 % in the respective two cuts, respectively (Table 6).

Creamy fodder cowpea type when planted at the lowest seeding rate (15 kg / fed). And the lowest stem diameters were obtained also from Creamy fodder cowpea planted at the highest seeding rate (45kg/ fed).

Whereas, it could be generally concluded that Creamy type of fodder cowpea was the superior type in stem diameter as compared with the other two types (Brown and Dotted) where they exerted significant differences in between. Also, the lowest population densities of fodder cowpeas for the lowest seeding rate per fed.(15 kg) could be advisable for producing highest stem diameter.

B-3. Leaf area / plant

Leaf area /plant for the selective studied indigenous-native legumes plants at various seeding rates for the obtained cuts of the two growing seasons and their combined analysis are presented in Table (7).

Bonavista Bean Type

The combined analysis (over the applied seeding rates), show no significant differences in leaf area /plant among the studied Bonavista bean types. However, leaf area /plant could be ranked in the following descending order: Brown (923.74cm^2) then White (911.92cm^2) followed by Black (857.96cm^2) without significant differences.

In this respect, the highest leaf area /plant was produced for the Brown type. This Brown type was of about 8 % higher in leaf area /plant as compared with the other two types of Bonavista bean (Black and White).

From the combined analysis, it is clear that the White, Black and Brown Bonavista bean types were of 1100.53, 1070.32 and 964.40 cm^2 leaf area/plant in the first cut without significant differences, respectively and being 883.08, 723.32and 645.60 cm^2 for Brown, White and Black type in the second cuts with significant differences . Also, it is generally noticed that leaf area/plant for all of the three types of B.bean were higher during the first than the second cut (Table 7).

It looks to be true that such slight variation in leaf area / plant of the different indigenous-native legumes is a specific nature of growth for each specific type of legumes according to its genetical makeup that interact differently with the prevailing environmental conditions under the circumstances of this study in specific patterns (Table 2-b).

The combined analysis over the grown types, results clarified that the obtained leaf area / plant of each of the grown Bonavista bean types substantially decreased as seeding rates significantly increased. As seeding rates increased from 10 to 20 and up to 30 kg /fed, leaf area/plant was significantly decreased with a respective areas of 1232.93, 870.03 and 590.67 cm^2 / plant. whereas, the lowest seeding rate (10 kg/fed) was of about 42% and 109% higher in leaf area / plant as compared with the medium (20 kg/fed) and highest seeding rate (30 kg /fed.). Meanwhile, the medium seeding rate was of about 47% higher in leaf area as compared with the highest seeding rates with appreciable significant differences.

It is clear that the decrease in leaf area /plant due to increasing seeding rate (from 10 to 20 and 30 kg/fed.) was obviously clear in both of the two seasons. This could be due to the increase of plant population densities per unit area of land. However, such increase in number of plants per unit area of land as well as the convenient microenvironment within plant canopies may be the reason of the obtained increase of fresh and dry yield as presented and discussed earlier.

However, it could be more likely true that the stored energy of growth and production will be saved rather than using such lost energy in survival and existence of plant under the harsh hot dry environmental conditions which used to be at the lightest planting population densities when using lower seeding rates. Moreover, the relatively larger number of plants / unit area of land may compensate for the lower area of leaves / plant and this was definitely reflected on the obtained total forage yield / unit area of land.

Also, the combined analysis showed significant differences in leaf area / plant between the Brown, White and Black Bonavista bean types within cuts (Table7). Over the used seeding rates, leaf area per plant of the first cuts was higher than of the second ones, with significant differences (Table 7).

So, it could be generally concluded that, the highest leaf area /plant was noticed for the White B.bean type (1100.53 cm^2) during the first cut with no significant differences. Whereas, the highest leaf area /plant during the second cut was for Brown type (883.08 cm^2) with significant differences (Table 7).

The interaction effect of Bonavista bean types and their seeding rates for leaf area /plant was significant for the individual cuts of the two seasons or their combined analysis (Table7). However, data evidenced that highest leaf area /plant was obtained for White type when planted at the lowest seeding rates (10kg/fed). Whereas, the lowest leaf area / plant was obtained from the Black type planted at the highest seeding rate (30kg/fed). In other words, it could be generally concluded that Brown type was the best selected types in leaf area / plant as compared with the other two types (White and Black type) where they did not exert significant difference in between.

Fodder Cowpea Types

Results from the combined analysis (over the applied seeding rates) revealed significant differences in leaf area /plant between the studied fodder cowpea types (Table7). However, the Creamy fodder cowpea type was of the highest leaf area /plant

($274.12cm^2$) then Brown type ($254.44cm^2$) followed by Dotted type ($243.05cm^2$) of fodder cowpea types (Table 7).

In this respect, The Creamy fodder cowpea type was of about 13% higher in leaf area /plant as compared with the other two types (Brown and Dotted).

It should be pointed out that there was a slight difference with no significant magnitudes between the obtained leaf area / plant of the three fodder cowpea types during the first season. Meanwhile, they showed significant differences during the second season where leaf area /plant ranked in the following descending order: Dotted, Brown and Creamy having leaf area / plant of 179.30, 177.37 and 176.36 cm^2 without significant differences in the first season. Whereas, the descending order during the second season was: Creamy, Brown and Dotted types having 371.43, 331.52 and 306.80 cm^2 leaf area/ plant respectively with significant differences (Table 7).

Seasonal variations in leaf area / plant of fodder cowpea types were relatively higher in the second than the first season. It looks to be true that such obtained variation in leaf area of the native fodder cowpea types is a specific nature of growth for each specific types according to its genetical makeup that interact differently with the prevailing environmental conditions under the circumstances of the experiment.

It is clear from the combined analysis of leaf area /plant that the Creamy type of fodder cowpea was highest during the first cut with significant differences as compared with the second one, whereas, Brown type was the highest in this trait with significant differences in the second cut (Table 7).

The combined analysis(over the grown fodder legumes) clarified that the obtained leaf area /plant of each of the grown fodder cowpea types substantially decreased as seeding rates increased significantly. As seeding rates increased from 15 to 30 and up to 45 kg/fed., leaf area / plant was substantially decreased respectively (354.85, 243.03 and 173.73 cm^2). The lowest seeding rate (15 kg/ fed.) produced plants of 104%

higher in leaf area / plant as compared with the other higher two seeding rates (30.and 45 kg /fed.).

In this respect, the decrease in leaf area /plant due to increasing seeding rate from (15 to 30 and 45) was more pronounced during the second than the first season. This result could be due to the seasonal difference in temperature which was relatively higher in the second season than the first one (Table 2-b).

Moreover, the combined analysis showed significant differences in leaf area / plant between the Creamy, Brown and Dotted fodder cowpea types within each of the two cuts (Table 7). In addition, over the applied seeding rates, leaf area / plant of the first cuts was larger than for the second ones, with lower leaf area / plant as seeding rate increased with significant differences.

The interaction effect of fodder cowpea types and their seeding rates for leaf area /plant was significant only during the first cut and the first season as well as the second cut of the second season or their combined analysis. However, results generally showed that the highest leaf area /plant was obtained for Creamy fodder cowpea type when planted at the lowest seeding rate (15 kg / fed). Meanwhile, the lowest leaf area / plant was obtained from Dotted fodder cowpea planted at the highest seeding rate (45kg/fed).

It could be generally concluded that Creamy type of fodder cowpea was the superior type in leaf area / plant as compared with the other two types (Brown and Dotted) where they exerted no significant differences in between.

Also, the lowest population densities of fodder cowpeas for the lowest seeding rate per fed.(15 kg) could be due to the more than adequate space between plants for the lowest seeding rates which more probably create less competition and abundant of adequate plant requirements for essential growth requirement. In the mean time, the larger number of plants per unit area of land and the convenient microenvironment within such plant canopies may compensate for producing more fresh and dry yield as previously presented and discussed.

Table (7):Leaf area per plant of the studied forage legumes at various seeding rates.

Types (T)	Density (D) kg / fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1[st] cut	2[nd] cut	Mean	1[st] cut	2[nd] cut	Mean	1[st] cut	2[nd] cut	Mean
Bonavista bean performance:					...........(Cm²)...........					
White	10	1420.35	1265.60	1342.98	2085.34	645.14	1365.24	1752.85	955.37	1354.11
	20	582.43	996.98	789.71	1116.56	543.82	830.19	849.50	770.40	809.95
	30	517.92	532.62	525.27	880.58	355.75	618.16	699.50	444.19	571.72
Mean		840.23	931.73	885.77	1360.83	514.90	937.86	1100.53	723.32	911.92
Black	10	846.70	774.46	797.08	1893.43	1066.72	1480.07	1370..06	907.09	1138.58
	20	773.64	308.21	540.93	1210.70	921.74	1066.22	992.17	614.97	803.57
	30	615.25	281.10	448.18	1082.22	548.38	815.30	٨٤٨,٧٢	414.97	631.74
Mean		745.20	445.59	595.40	1395.45	845.61	1120.53	1070.32	645.60	857.96
Brown	10	652.16	817.08	734.62	1796.66	1558.48	1677.57	1224.41	1187.78	1206.10
	20	647.46	745.03	696.25	1652.27	941.52	1296.90	1149.87	843.28	996.57
	30	329.71	419.84	374.78	708.11	816.56	762.33	518.91	618.20	568.56
Mean		543.11	660.65	601.88	1385.68	1105.52	1245.60	964.40	883.08	923.74
10		973.07	943.38	958.23	1925.15	1090.11	1507.63	1449.11	1016.75	1232.93
20		667.84	683.40	675.65	1326.51	802.32	1064.41	997.18	742.88	870.03
30		487.63	411.19	449.44	890.30	573.56	731.93	688.96	492.38	590.67
Mean		709.51	679.32	694.44	1380.65	822.0	1101.32	1045.08	750.67	897.88
L.S.D at: 5% for :		T= 111.33, D= 125.06, TD= 216.60	T= 116.67, D= 140.46, TD= 243.29	T= 95.03, D=102.16, TD=176.95	D= 98.08, TD= 168.88	T= 95.85, D=131.57, TD=227.88	T= 124.18, D= 72.51, TD= 125.6	D= 76.99, DY= 108.0, TDY= 188.1	T= 67.21, D= 92.99, TY= 95.04, TDY= 227.8	D= 60.53, TY= 98.43, DY= 85.61, TD=104.84, TDY= 148.3
Fodder cowpea performance:										
Creamy	15	357.25	119.28	238.27	591.17	351.84	471.51	474.21	235.56	354.88
	30	239.21	74.92	157.06	464.97	315.38	390.18	352.09	195.15	273.62
	45	201.89	68.37	135.13	369.64	135.54	252.59	285.77	101.96	193.86
Mean		266.12	87.52	176.82	475.26	267.59	371.43	370.69	177.55	274.12
Brown	15	447.92	146.90	297.41	494.49	417.22	455.86	471.21	282.06	376.63
	30	193.92	104.92	149.42	449.01	429.75	339.38	321.47	167.34	244.40
	45	98.73	71.82	85.27	259.01	139.61	199.31	178.87	105.71	142.29
Mean		246.86	107.88	177.37	400.84	262.19	331.52	323.85	185.04	254.44
Dotted	15	447.22	104.43	275.82	419.97	360.51	390.24	433.59	232.47	333.03
	30	213.85	69.60	141.72	379.32	181.54	280.43	296.59	125.57	211.08
	45	189.23	51.43	120.33	362.87	136.58	249.73	276.05	94.0	185.03
Mean		283.43	75.16	179.30	387.38	226.21	306.80	335.41	150.68	243.05
15		417.46	123.54	270.50	501.88	376.52	439.20	459.67	250.03	354.85
30		215.66	83.15	149.41	431.09	242.23	336.66	323.38	162.69	243.03
45		163.28	63.87	113.58	330.51	137.24	233.88	246.89	100.56	173.73
Mean		265.47	90.19	177.83	421.16	252.0	336.58	343.31	171.09	257.20
L.S.D at: 5% for :		D= 40.93, TD= 70.90	T= 12.15, D= 17.70	D= 21.61, TD=37.45	T= 45.34, D= 80.46	T= 35.38, D= 29.59, TD=51.26	T= 30.50, D= 43.76	T= 27.86, D= 43.62, TY= 39.40, DY= 61.88	T= 16.65, D= 16.66, DY=23.56, TD= 28.86, TDY= 40.81	T= 17.33, D= 23.58, DY= 33.35, TY= 24.52, TD= 40.85

B-4. Leaf / stem ratio

Results of Leaf /stem ratio for the selective studied indigenous-native legume plants at various seeding rates for the obtained cuts of the two growing seasons and their combined analysis are presented in Table (8).

Bonavista Bean Types

Data for the combined analysis (over the applied seeding rates) revealed appreciable differences in Leaf /stem ratio among the studied Bonavista bean types with variable significant magnitudes. Leaf /stem ratio could be ranked in the following descending order: Brown (0.84) then White (0.81) followed by Black (0.67).It should be noted that the highest leaf /stem ratio was recorded for the Brown type of Bonavista bean, whereas, the lowest one was for the Black type. The Brown type was of about 25 % higher in leaf /stem ratio as compared with the other two types of Bonavista bean(Black and White).

Also, it looks to be true that there was significant differences between the obtained leaf /stem ratio of the three B. bean types within each of the two summer seasons. Leaf /stem ratio could be ranked in the following descending order: Brown then White followed by Black type in the first season and being White, Brown and Black Bonavista bean types in the second season with significant differences.

Results of the combined analysis noted that the Black Bonavista bean type was similar in leaf /stem ratio for each of the obtained cuts. Whereas, the other two types (White and Brown) were of slightly higher leaf /stem ratio for the second than the first cuts (Table 8).

It is obviously clear that, such obtained variation in leaf /stem ratio of the different types is a specific nature of its growth according to its genetical makeup and its interaction with the prevailing environmental conditions under the circumstances of this study (Table 2-b). **Foster *et al.* (2009)** in Bonavista bean reported similar observations.

Over the grown Bonavista bean types, the combined analysis showed that no significant differences in leaf /stem ratio of plants at the applied seeding rates (Table 8). The obtained leaf /stem ratio of plants for each of the grown Bonavista bean type substantially decreased as seeding rates increased with no significant differences. As seeding rates increased, leaf /stem ratio of plants decreased with a respective ratios of 0.97, 0.78 and 0.75.

It is also clear that the decrease in leaf /stem ratio of plants due to increasing seeding rate (from 10 to 20 and 30 kg/fed.) was more noticed in both of the two seasons. Also, the combined analysis indicated significant differences in leaf /stem ratio among the Brown, White and Black Bonavista bean plant types during the first cut (Table 8). Meanwhile, over the used seeding rates, leaf /stem ratio of the second cuts were higher than for the first ones, having lower leaf / stem ratios as seeding rates increased with significant differences during the first cut only.

In other words, it could be concluded that the highest leaf /stem ratio was for plants of Brown B.bean type (0.84) during the first cut with significant differences. Whereas, other results for the same type of plants was noticed during the second cut (the lowest type) but without significant differences (Table 8).

The interaction effect of Bonavista bean types and their seeding rates for leaf / stem ratio was significant for the individual cuts of the two seasons or their combined analysis (Table 8). However, results clarified that highest leaf / stem ratio was obtained for plants of Brown type when planted at the medium seeding rates (20kg/fed). Meanwhile, the lowest leaf / stem ratio was obtained for plants of Black type, planted at the highest seeding rate (30kg/fed). In other words, it could be generally concluded that Brown type was the best selected types in leaf / stem ratio as compared with the other two types (White and Black type) where they exerted significant difference in between.

Also, the lowest insignificant number of plants per unit area of land from the lowest seeding rate (10 kg/fed.) could be the reason for producing higher leaf /stem ratio due to the extra uncovered soil surface. However, the high number of plants (from the

higher seeding rates) insured highest fresh and dry forage yield. This is a matter of more harvest of solar energy per unit area of land.

Fodder Cowpea Types

The combined analysis (over the applied seeding rates) showed significant differences in leaf / stem ratio between the studied fodder cowpea types (Table 8). However, The Brown fodder cowpea type was of the highest leaf / stem ratio (0.74). Whereas, the Creamy and Dotted fodder cowpea types recorded almost similar leaf / stem ratio which were 0.67 and 0.65 respectively. Moreover, the Brown type plants was of about 14 % higher in leaf / stem ratio as compared with the other two types of fodder cowpea (Creamy and Dotted).In this respect, the Creamy fodder cowpea type was of about 13 % higher in leaf area /plant as compared with the other two types (Brown and Dotted).

It should be pointed out that there was a slight insignificant difference between the obtained leaf /stem ratio of the three fodder cowpea types in the first season. Meanwhile, they exerted slight significant differences during the second season. Leaf /stem ratio of Creamy, Brown and Dotted could be ranked in the following descending order: 0.61, 0.60 and 0.54, respectively without significant differences in the first season. Meanwhile, Brown, Dotted and Creamy types produced leaf / stem ratio of 0.89, 0.76 and 0.74 respectively with very slight significant differences in the second season (Table8).

Also, such obtained differences were noticed between the two seasons where leaf / stem ratios were slightly higher in the second than the first season. It looks to be true that such obtained fluctuated variation in leaf / stem ratio of plants for fodder cowpea types were due to their different specific nature of growth according to its genetical makeup and its interaction with the circumstantial environmental conditions. Similar results were reported by **Foster *et al.* (2009)** in fodder cowpea.

The combined analysis (Over the grown fodder legumes) revealed that the obtained leaf / stem ratio of plant for each of the grown fodder cowpea types substantially

Table (8): Leaf / Stem ratio per plant of the studied forage legumes at various seeding rates.

Types (T)	Density (D) kg / fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Bonavista bean performance: .... (% on fresh weight basis)........................										
White	10	0.70	0.76	0.73	0.89	1.13	1.01	0.79	0.94	0.87
	20	0.57	0.73	0.65	0.88	0.97	0.93	0.73	0.85	0.79
	30	0.69	0.90	0.80	0.52	0.99	0.76	0.61	0.94	٠.٧٧
Mean		0.65	0.79	0.72	0.76	1.03	0.90	0.71	0.91	0.81
Black	10	0.65	0.70	.68٠	0.90	0.64	0.77	0.78	0.67	0.72
	20	0.54	0.51	0.53	0.72	0.79	0.76	0.63	0.65	0.64
	30	0.60	0.66	0.63	0.59	0.72	0.65	0.59	0.69	0.64
Mean		0.59	0.62	0.61	0.74	0.71	0.73	0.67	0.67	0.67
Brown	10	0.83	0.76	0.80	0.82	0.71	0.76	0.82	0.73	0.78
	20	1.00	0.92	0.96	0.74	1.00	0.87	0.87	0.96	0.92
	30	0.64	0.69	0.67	0.76	1.20	0.98	0.70	0.95	0.82
Mean		0.82	0.79	0.81	0.77	0.97	0.87	0.80	0.88	0.84
10		0.72	0.74	0.73	0.87	0.83	0.85	0.80	0.78	0.79
20		0.70	0.72	0.71	0.80	0.92	0.86	0.74	0.82	0.78
30		0.64	0.75	0.70	0.62	0.97	0.80	0.63	0.86	0.75
Mean		0.69	0.74	0.71	0.76	0.91	0.84	0.72	0.82	0.77
L.S.D at: 5% for :		T= 0.08, TD= 0.20	T= 0.10, TD= 0.15	T= 0.07, TD=0.15	T= 0.06, TD= 0.10	T= 0.11, TD= 0.29	T= 0.06, TD= 0.12	T= 0.05, D= 0.06, TY= 0.08, DY= 0.09, TDY= 0.15	T= 0.07, TDY=0.23	T=0.05, TD= 0.09, TDY= 0.13
Fodder cowpea performance:										
Creamy	15	0.60	0.61	0.61	0.55	0.86	0.71	0.57	0.73	0.65
	30	0.54	0.69	0.61	0.56	0.99	0.78	0.55	0.84	0.70
	45	0.52	0.67	0.60	0.42	1.06	0.74	0.47	0.86	0.67
Mean		0.55	0.66	0.61	0.51	0.97	0.74	0.53	0.81	0.67
Brown	15	0.56	0.52	0.54	0.71	1.06	0.88	0.63	0.79	0.71
	30	0.46	0.61	0.53	0.65	1.05	0.85	0.56	0.83	0.70
	45	0.63	0.79	0.71	0.49	1.35	0.92	0.56	1.07	0.81
Mean		0.55	0.64	0.60	0.61	1.16	0.89	0.58	0.90	0.74
Dotted	15	0.56	0.71	0.64	0.59	0.77	0.68	0.57	0.74	0.66
	30	0.26	0.68	0.47	0.63	0.84	0.74	0.45	0.76	0.60
	45	0.34	0.65	0.50	0.56	1.18	0.87	0.45	0.91	0.68
Mean		0.39	0.68	0.54	0.59	0.93	0.76	0.49	0.81	0.65
15		0.57	0.62	0.60	0.62	0.90	0.76	0.59	0.76	0.67
30		0.42	0.66	0.54	0.62	.96٠	0.79	0.52	0.81	0.67
45		0.50	0.70	0.60	0.49	1.20	0.85	0.49	0.95	0.72
Mean		0.50	0.66	0.58	0.58	1.02	0.80	0.53	0.84	0.69
L.S.D at: 5% for :		T= 0.11, D= 0.04, TD= 0.07	N.S	D=0.05, TD=0.08	T= 0.08, D= 0.06	T= 0.16, D= 0.19	T= 0.06	T= 0.06, D= 0.04, TY= 0.08, DY= 0.05, TDY= 0.09	T= 0.08, D= 0.10, TY= 0.11	T= 0.05, TY= 0.07, TDY= 0.13

decreased as seeding rates increased. Whereas, differences did not reach the level of significance. As seeding rates increased from 15 to 30 and up to 45 kg/fed. Leaf /stem ratio of plants was slightly decreased without significant differences (0.72, 0.67 and 0.67, respectively).

Moreover, such increase in leaf /stem ratio was somewhat more clear during the second than the first season. This could be due to the environmental variations with the two seasons (Table 2-b).

In other words, the combined analysis showed significant differences in leaf / stem ratio of plants between Brown, Creamy and Dotted fodder cowpea types within each of the two cuts (Table 8). In addition, over the tried seeding rates, leaf /stem ratio of the second cuts was higher than the first ones, with lower ratios as seeding rate increased with significant differences.

The interaction effect of fodder cowpea types and their seeding rates on leaf / stem ratio of plants was significant during the first cut and the first season as well as the combined analysis of the two seasons. However, results clarified that the highest leaf / stem ratio of plants was noticed for Brown fodder cowpea type when planted at the highest seeding rate (45 kg / fed). Meanwhile, the lowest leaf /stem ratio was obtained from Dotted fodder cowpea planted at the same highest seeding rate. Whereas, it could be generally concluded that Brown type of fodder cowpea was the higher type in leaf /stem ratio as compared with the other two types (Creamy and Dotted) where they did not exert any significant differences in between.

B-5. Light intensity effect

As it is well known that the difference in light intensities between the far top of the grown plants and the soil surface could be used as rough indicator of the intensity and shading within plants canopies.

Bonavista Bean Types

Results in Table (9) represent light intensity effect of the studied indigenous-native leguminous forage plants at various seeding rates for the obtained cuts of the two growing seasons and their combined analysis as well.

Combined analysis (over the applied seeding rates) revealed significant differences in light intensity between the far top and soil surface of plants. Data revealed that among the studied Bonavista bean types Light intensity differences could be ranked in the following descending order: White (83291lux) then Black (82181lux) followed by Brown (81279lux).Whereas, The White type was of about 2.5 % higher in light intensity differences as compared with the other two types of Bonavista bean (Black and Brown type).This result may mean more light radiation absorption through their foliage than the other two types.

In this respect, the highest light intensity difference was recorded for the White type, whereas, the lowest difference was for the Brown type (Table 9). This result may indicate that such type of Bonavista bean was the superior in vegetative growth for light interception which stimulate active photosynenthesis and forage production.

Nature of foliage and structure for each of the studied types is more likely responsible for its function in light absorption.

It looks to be true that there was an appreciable significant differences between the obtained light intensity difference between the three Bonavista bean types during the second summer season. Light intensity difference could be ranked in the following descending order: White then Black followed by Brown type of Bonavista bean in the first season where differences did not reach the significant levels. Meanwhile, the ranking order was of Black, Brown and White Bonavista bean types in the second season with very slight significant differences (Table 9).

The combined analysis clarified that the White, Black and Brown Bonavista bean types recorded 87576.63, 86015.38 and 85886.63 lux in the first cut with significant differences and being 79005.54, 78356 and 76356.71 lux in the second cuts with no

significant differences . Whereas, it is noticed that the first cut was higher than the second cuts of light intensity difference (Table 9).

It should be pointed out that such obtained variation in light intensity difference of the different Bonavista bean types is a specific nature of their growth and according to their genetical makeup and interaction with the prevailing circumstances of this study regarding intensity of plantation and nature of vegetative growth proliferation (Table 2-b).

From the combined analysis (over the grown indigenous-native forage legumes), the obtained light intensity difference of each of the grown Bonavista bean types increased as seeding rates increased significantly. In other words, as seeding rates increased from 10 to 20 and up to 30 kg /fed, light intensity difference was significantly increased with a respective light intensity difference of 79587.02, 82205.90 and 84963.83 lux, whereas the highest seeding rate was of about 7 % higher in light intensity difference as compared with the other two seeding rates (10 and 20 kg /fed.).

It should be generally noticed that the obtained total increase in light intensity difference due to increasing seeding rate was more clear in both of the two seasons. This result may indicate that the higher number of plants / unit area of land is a good vegetative cover that have more efficient use of the solar radiation which in turn affect fresh and dry forage yield in general.

Also, the combined analysis showed significant differences in light intensity difference between the White, Black and Brown Bonavista bean types within each of the two cuts (Table 9). Over the used seeding rates, light intensity difference during the first cuts was higher than the second cuts with slight significant differences.

It is also noticed that, the highest light intensity difference for the White Bonavista bean type was 87576.63 lux in the first cut with slight significant differences. and the second cut with no significant differences (Table 9). **Hodgson and Blackman (2005)**

studied the response of faba bean to the light intensities which was almost similar to Bonavista bean.

The trend of the individual cuts for each of grown Bonavista bean types and the applied seeding rates were more or less similar to the obtained seasonal light intensity difference and the combined analysis as it is clear from Table (9).

The interaction effect of Bonavista bean types and their seeding rates on light intensity difference was significant for the individual cuts of the two seasons or their combined analysis (Table 9). However, results evidence that highest light intensity difference was obtained for White type when planted at the highest seeding rates (30kg/fed). Meanwhile, the lowest light intensity difference obtained for Brown type, planted at the lowest seeding rate (10kg/fed). In other words, it could be generally concluded that White type was the best selected types in light intensity difference as compared with the other two types (Brown and Black type).where they showed significant differences in between.

Also, the population densities per unit area of land for the highest seeding rate (30 kg/fed.) could be advisable for achieving better performance of the highest number of plants per unit area of land from subjecting and absorbing the utmost of visible solar radiation by the optimum soil covering of the target plants . Such benefit will be reflected in photosynthetic activity products which will be accumulated in fresh and dry forage yield.

Nature of foliage and structure for each of the studied types is more likely responsible for its function in light absorption.

Fodder Cowpea Types

Results from the combined analysis (over the applied seeding rates) clarified that significant differences in light intensity difference between the studied fodder cowpea types (Table 9). However, The Brown fodder cowpea type was of the highest light intensity difference (80882.94lux) then Creamy type (79267.19lux) followed by Dotted type (78929.67lux) (Table 9).The Brown fodder cowpea type was of about 2.5

% higher in light intensity difference as compared with the other two types (Creamy and Dotted).

Nature of foliage and structure for each of the studied types is more likely responsible for its function in light absorption.

Light intensity difference could be ranked in the following descending order: Creamy, Brown and Dotted types recorded 78383.12, 76820.29 and 76658.46 lux, respectively with no significant differences in the first season. Whereas, the respective order was 81200.37, 80151.25 and 78494 lux for Dotted, Creamy and Brown types, respectively with slight significant differences during the second season. (Table 9). Also, light intensity difference in generally was relatively higher in the second than the first season (Table 9).

It is clear from the combined analysis of light intensity difference; the Dotted type cowpea was the highest during the first cut with no significant differences. Meanwhile, the Brown type was highest with significant differences in the second cut (Table 9).

The combined analysis(over the grown fodder legumes) revealed that the obtained light intensity difference of each of the grown fodder cowpea types significantly increased as seeding rates increased. As seeding rates increased from 15 to 30 and up to 45 kg/fed. Light intensity difference was increased with a respective of 75831.88, 80663.17 and 82584.75lux. whereas, the highest seeding rate was of about 9 % higher in light intensity difference as compared with the other two seeding rates (15.and 30kg /fed.). The adequate plants soil cover of better subjecting to solar radiation as well as creating more convenient microenvironment within the grown plants. In this respect, the increase in light intensity difference due to increasing seeding rate was more pronounced during the second than the first season.

Combined analysis exerted significant differences in light intensity difference between the 3 types within each of the two cuts (Table 9). In addition, over the applied seeding rates, light intensity difference of the first cuts was higher than for the second ones,

Table (9): Light intensity of the studied forage legumes at various seeding rates.

Types (T)	Density (D) kg / fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Total	1st cut	2nd cut	Mean
Bonavista bean performance:					.... (Lux)					
White	10	86058.25	72046.50	79052.38	87809.75	78698.50	83254.12	86934.0	75372.50	81153.25
	20	86410.75	78302.25	82356.50	88074.0	81158.25	84616.12	87242.38	79730.25	83486.31
	30	87944.25	80409.50	84175.37	89165.75	83418.25	86246.12	88553.50	81913.88	85233.69
Mean		86803.42	76919.42	81861.43	88349.83	81091.66	74720.74	87576.63	79005.54	83291.08
Black	10	85972.75	72764.25	79368.50	83313.25	77104.0	80208.62	84643.0	74934.13	79788.56
	20	86280.0	73067.50	79673.75	85425.50	81901.25	83663.37	85852.75	77484.38	81668.56
	30	88087.75	79344.75	83706.25	87033.0	85958.50	86495.75	87550.38	82651.63	85101.0
Mean		86773.50	75058.83	80916.16	85257.25	81654.58	83455.91	86015.38	78356.71	82186.04
Brown	10	84965.25	69153.75	77059.50	84077.50	73080.50	78579.0	84521.38	71117.13	77819.25
	20	86360.75	74502.0	80431.37	85631.0	79357.50	82494.25	85995.88	76929.75	81462.81
	30	87138.50	81693.0	84415.75	87146.75	82249.0	84697.87	87142.63	81971.0	84556.81
Mean		86154.83	75116.25	80635.54	85618.42	78229.0	81923.71	85886.63	76672.63	81279.63
10		85665.45	71321.50	78493.46	85066.83	76249.33	80680.58	85366.13	73807.92	79587.02
20		86350.50	75290.58	80820.54	86376.83	80805.66	83521.24	86363.67	78048.13	82205.90
30		87715.83	80482.42	84099.13	.7781.83^	83875.75	85828.54	87748.83	82178.83	84963.83
Mean		86577.25	68480.06	81137.71	86408.50	80325.08	83366.79	86492.88	78011.63	82252.25
L.S.D at: 5% for :		N.S	D= 3100.54	D= 1905.62	T= 1521.22	T= 2363.69, D= 2353.07	T= 1359.95, D= 1480.35	T= 1473.14, D= 1410.95	D= 1880.64	T= 1455.19, D= 1165.91
Fodder cowpea performance:										
Creamy	15	82016.50	66933.25	74474.88	85096.0	69096.50	77096.50	83556.25	68014.88	75785.56
	30	88116.25	68370.0	78243.12	86887.50	74997.50	80942.50	87501.88	71683.75	79592.81
	45	88329.50	76533.25	38310.12	87170.0	77660.0	82415.0	87749.75	77096.63	82423.19
Mean		86154.08	70612.16	78383.12	86384.50	73918.0	80151.25	86269.29	72265.08	79267.19
Brown	15	80954.25	57586.50	69270.37	87279.25	81097.50	84188.37	84116.75	69342.0	76729.38
	30	86981.75	73025.0	80003.37	87644.75	82625.0	85134.88	87313.25	77825.0	82529.38
	45	88390.50	73983.75	81187.12	87957.0	83070.0	85513.5	88173.75	78526.88	83350.31
Mean		85442.16	68198.42	76820.29	87627.0	82264.17	78494.85	86534.58	75231.29	80882.94
Dotted	15	86030.0	53723.25	69876.62	86199.25	73970.27	80084.76	86114.63	63846.75	74980.69
	30	86600.50	72227.25	79413.88	86355.0	74127..50	80241.25	86477.75	73177.38	79827.56
	45	87434.50	73938.25	80686.38	87919.25	78631.0	83275.12	87676.88	76284.63	81980.75
Mean		86688.33	66629.58	76658.46	86824.50	75576.25	81200.37	86756.42	71102.92	78929.67
15		83000.25	59414.33	71207.29	86191.50	42474.21	80456.46	84595.88	67067.88	75831.88
30		87232.83	71207.42	79220.12	86962.42	77250.0	82106.21	87097.63	74228.71	80663.17
45		88051.50	74818.42	81434.96	87682.08	79787.0	83734.54	87866.79	77302.71	82584.75
Mean		86094.86	68480.06	77287.45	86945.33	77252.81	82099.07	86520.10	72866.43	79693.27
L.S.D at: 5% for :		D= 3435.32	D= 4244.85, TD=7352.97	D= 3115.47	N.S	T= 3439.39, D= 3011.92	T=1903.29, D=1629.19	D= 1769.59	T= 2289.69, D= 2514.82, TY=3238.12, DY=3556.46 TDY=6160.0	T= 1538.65, D= 1698.68, TY= 2175.97 DY= 2402.3

with higher differences as seeding rate increased with significant differences. The trend of the individual cuts for each of grown F. cowpea types and the applied seeding rates were more or less similar to the obtained seasonal light intensity difference and the

Combined analysis as it is clear from (Table 9). Almost similar results were reported by **Ball *et al.* (2000)** in soybean and **Meekins and McCarthy (2000)** in Alliaria.

The interaction effect of fodder cowpea types and their seeding rates on light intensity difference was significant only for the second cut of the first season and the second cut for the mean of the combined analysis. However, results generally exerted that the highest light intensity difference was obtained for the Brown cowpea type when planted at the highest seeding rate (45kg/fed). Meanwhile, the lowest light intensity difference was obtained from Dotted fodder cowpea, planted at the lowest seeding rate (15 kg/fed). Whereas, the Dotted type of fodder cowpea was the superior type in light intensity difference as compared with the other two types (Brown and Creamy) where they did not show significant differences in between. Also, the population densities for the highest seeding rate per fed.(45kg) may be advisable for producing highest light intensity difference. Among such reasons, are then large number of plants per unit area of land of better soil cover, and creating convenient environmental and edaphic condition within plant canopies and improving the edaphic condition of the soil. Moreover, encouranging micro flora which keeps the soil alive for various essential biological activities in respect of improving soil physical, chemical characteristics.

B-6. Number of shoots/m^2

Number of shoots/m^2 for the selective studied indigenous-native legumes plants at various seeding rates for the obtained cuts of the two growing seasons and their combined analysis are presented in Table (10).

Bonavista Bean Types

The combined analysis (over the applied seeding rates) clarified that no significant differences in number of shoots among the studied Bonavista bean types. Meanwhile,

number of shoots/m^2 could be ranked in the following descending order: White (19.8) then Brown (18.3) followed by Black (14.8) significance. Whereas, the White type was of about 34 % higher in number of shoots as compared with either of the other two types of Bonavista bean (Brown and Black type).

It looks to be true that, there was an appreciable significant difference between the obtained number of shoots /m^2 of the three B. bean types during the second summer season. Number of shoots /m^2 could be ranked in the following descending order: Black then Brown followed by White type without significant differences in the first season being White, Brown then Black types in the second season with slight significant differences.

The combined analysis clarified that the White, Brown and Black Bonavista bean types produced 24.8, 20.3 and 17.3 shoots / m^2 in the first cut (with no significant differences), and the Brown, White and Black types produced 16.3, 14.7 and 12.3 shoots/m^2 in the second cuts with slight significant differences, respectively. Also, it is noticed that the first cuts was higher than the second cuts in this studied trait.

The combined analysis (over the grown indigenous-native forage legumes) indicated that the obtained number of shoots /m^{2}of each of the grown Bonavista bean types increased as seeding rates increased with slight significant differences. As seeding rates increased from 10 to 20 and up to 30 kg /fed number of shoots /m^2 was significantly increased with a respective number of shoots /m^2 10.8, 16.8 and 25.4 shoots/m^2. whereas, the highest seeding rate was of about 135 % higher in number of shoots/m^2 as compared with the other two seeding rates. Such results may indicate that higher plant population densities of plants / unit area of land as well may create favorable moisture, shading and lower temperature with less soil evaporation as well as favorable edaphic condition that would end up with more number of shoots per unite area of land within plant canopies. This trend was more clear during each of the two seasons.

Also, the combined analysis showed slight significant differences in number of shoots /m^2 between the White, Brown and Black Bonavista bean types for each of the two

cuts, where number of shoots /m^2 of the first cuts were higher than the second cuts, with slight significant differences.

So, it could be concluded from the combined analysis that highest number of shoots /m^2 was obtained from the White B.bean type (24.8 shoots/m^2) during the first cut with no significant differences as compared with the other types. And Brown B. type (16.3 shoots/m^2) during the second cut with slight significant differences (Table 10). **El-Karamany (2006)** in local mung bean reported similar results.

The interaction effect of B. bean types and their seeding rates on number of shoots /m^2 was significant for the individual cuts and means of the second season and their combined analysis as well (Table 10). However, results evidentiate that highest number of shoots /m^2 was obtained for White B. bean type when planted at the highest seeding rates (30kg/fed), whereas, the lowest number of shoots /m^2 was obtained for Black Bonavista bean type, planted at the lowest seeding rate (10kg/fed).

It could be generally concluded that White B. bean type was the best selected types in number of shoots /m^2 as compared with the other two types (Brown and Black type) where they did not exert significant differences in between.

Also, the population densities per unit area of land for the highest seeding rate (30 kg/fed.) could be advisable for producing higher number of shoots /m^2 since the larger number of plants per unit area of land help plant to shade each other and keep reasonable moisture in between and cutting down the evaporation rates and reducing the soil temperature and finally encourage the well needed soil microflora that keeps the soil alive for the well known different variety reasons especially in the dry- hot desert area.

Fodder Cowpea Types

Results from the combined analysis (over the applied seeding rates) indicated significant differences in number of shoots /m^2 between the studied fodder cowpea types (Table 10). However, Creamy type was of the highest number of shoots /m^2

(91.7 shoots/m^2) then Dotted type (87.7 shoots/m^2) followed by Brown type (83.8 shoots/m^2) (Table10).

In this respect, The Creamy fodder cowpea type was of about 9.4% higher in number of shoots /m^2 as compared with the other two types (Dotted and Brown).It seems to be true that, there was significant differences between the obtained number of shoots /m^2 of the three fodder cowpea types in the first season, without significant differences during the second season. Number of shoots/m^2 could be ranked in the following descending order: Creamy, Dotted and Brown types produced 107.2, 91.4 and 87.4 shoots/m^2, respectively with significant differences in the first season and with insignificant differences for the second season. Also, number of shoots/m^2 generally was relatively higher in the first than the second season

It is clear from the combined analysis that number of shoots /m^2 of Creamy type of fodder cowpea was highest in both of the two cuts with slight significant differences (Table 10).The combined analysis(over the grown seasons) revealed that the obtained number of shoots /m^2 of each of the grown fodder cowpea types increased as seeding rates increased significantly. As seeding rates increased from 15 to 30 and up to 45 kg/fed., number of shoots/m^2 was increased to be 53.3, 91.4 and 118.3 shoots/m^2, whereas, the highest seeding rate was of about 122 % higher in number of shoots /m^2 as compared with the other two lower seeding rates. In this respect, the increase in number of shoots/m^2 due to increasing seeding rate was more clear during the first than the second season.

In other words, the combined analysis exerted significant differences in number of shoots/m^2 between the Creamy, Dotted and Brown fodder cowpea types within each of the two cuts (Table 10). In addition, over the applied seeding rates, number of shoots/m^2 of the first cuts was higher than the second seasons, with higher differences as seeding rate increased with significant differences. Similar results were reported by **El Karamany (2006)** in local mung bean.

The interaction effect of fodder cowpea types and their seeding rates on number of shoots/m^2 was significant only for the first cut and the mean of the two seasons and

Table (10): Number of shoots per sq. meter of the studied forage legumes at various seeding rates.

Types (T)	Density (D) kg / fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Bonavista bean performance .... (# of shoots/m²)........................										
White	10	10.0	10.0	10.0	15.0	11.0	13.0	12.5	10.5	11.5
	20	14.0	13.0	13.5	36.0	16.0	26.0	25.0	14.5	19.8
	30	20.0	19.0	19.5	54.0	19.0	36.5	37.0	19.0	28.0
Mean		14.7	14.0	14.4	35.0	15.3	25.2	24.8	14.7	19.8
Black	10	6.0	9.0	7.5	9.0	9.0	9.0	7.5	9.0	8.8
	20	10.0	10.0	10.0	15.0	14.0	14.5	12.5	12.0	12.3
	30	44.0	14.0	29.0	20.0	18.0	19.0	32.0	16.0	24.0
Mean		20.0	11.0	15.5	14.7	13.7	14.2	17.3	12.3	14.8
Brown	10	10.0	13.0	11.5	13.0	14.0	13.5	11.5	13.5	12.5
	20	13.0	15.0	14.0	32.0	13.0	22.5	22.5	14.0	18.3
	30	18.0	20.0	19.0	36.0	23.0	29.5	27.0	21.5	24.8
Mean		13.7	16.0	14.9	27.0	16.7	21.9	20.3	16.3	18.3
10		8.7	10.7	9.7	12.3	11.3	11.8	10.5	11.0	10.8
20		12.3	12.7	12.5	27.7	14.3	21.0	20.0	13.5	16.8
30		27.3	17.7	22.5	36.7	20.0	28.4	32.0	18.8	25.4
Mean		16.1	13.7	14.9	25.2	14.9	20.4	20.8	14.4	17.6
L.S.D at: 5% for :		N.S	T= 3.28, D= 2.31	D= 8.9	T= 4.05, D= 3.11, TD= 5.39		D= 1.84, TD= 3.18	T= 2.49, D= 1.84, TD= 3.18	TY= 12.95, D= 8.32	TY= 6.34, D= 4.39
Fodder cowpea performance:										
Creamy	15	70.0	49.0	59.5	45.0	43.0	44.0	57.5	46.0	51.8
	30	153.0	92.0	122.5	83.0	71.0	77.0	118.0	81.5	99.8
	45	174.0	105.0	139.5	129	86.0	107.5	151.5	95.5	123.5
Mean		132.3	82.0	107.2	85.7	66.7	76.2	109.0	74.3	91.7
Brown	15	40.0	44.0	42.0	55.0	40.0	47.5	47.5	42.0	44.8
	30	97.0	73.0	85.0	96.0	65.0	80.5	96.5	69.0	82.8
	45	163.0	107.0	135.0	142.0	83.0	112.5	152.5	95.0	123.8
Mean		100.0	74.7	87.4	97.7	62.7	80.2	98.8	68.7	83.8
Dotted	15	72.0	48.0	60.0	91.0	43.0	67.0	81.50	45.5	63.5
	30	120.0	79.0	99.5	102.0	66.0	84.0	111.0	72.5	91.8
	45	125.0	104.0	114.5	122.0	80.0	96.0	123.5	92.0	107.8
Mean		105.7	77.0	91.4	105.0	63.0	84.0	105.3	70.0	87.7
15		60.7	47.0	53.9	63.7	42.0	52.9	62.2	44.5	53.3
30		123.3	81.3	102.3	93.7	67.3.	80.5	108.5	74.3	91.4
45		154.0	105.3	129.7	131	83.0	107.0	142.5	94.2	118.3
Mean		112.7	77.9	95.3	96.1	64.1	80.1	104.4	71.0	87.7
L.S.D at: 5% for :		T= 12.34, D= 16.31, TD= 27.3	D= 10.28	T= 6.99, D= 10.8, TD=18.7	T= 9.09, D= 10.98, TD= 19.02	D= 6.09	D= 6.4, TD=11.08	T= 6.82, D= 9.50, TY= 9.65, DY=13.44 TD= 16.46	D= 5.77, DY= 8.17	T= 4.37, D= 6.07, TY= 6.18, DY= 8.58, TD= 10.50

their combined analysis as well. However, results generally indicated that the highest number of shoots/m^2 was obtained for the Brown fodder cowpea type when planted at the highest seeding rate (45kg/fed). Whereas, the lowest number of shoots was obtained from Brown type when planted at the lowest seeding rates (15kg/fed). Also, the population densities of fodder cowpeas between plants for the highest seeding rate per fed.(45 kg) may be advisable for producing highest number of shoots/m^2.

C- Chemical constituents

It should be pointed out that chemical analysis was conducted for the first and second cuts of each of the two growing seasons. Also, the chemical constituents for leaves and stems of the obtained indigenous-native forage legume materials were analyzed separately and presented on dry matter basis as follows:

Crude Protein (CP) Content

Bonavista Bean Types

Over the tested population densities, combined analysis (Table 11) indicated significant variations in CP content between the three types inspite of the very narrow range in between for leaves and stems with much higher values in leaves rather than stems. The descending ranking order for CP content was 20.93, 19.93 and 19.19% for Brown (Br), Black (B) and White (W) Bonavista bean types in leaves; whereas, in stem, the descending ranking order was for white, Brown and Black Bonavista bean being 9.52, 8.53 and 7.86%. So, it is well noticed that each of the 3 types varied in their CP content in their leaves and stems with slight significant differences. So, it is well noticed that White type of Bonavista bean was of the lowest leaf-C.P content (19.19%) and the highest in stem (9.52%) content; whereas, Brown type was of the highest (20.93%) CP level in leaves and the lowest 8.53% in stems.

Crude protein contents were relatively higher for the first growing season than the second one especially for leaves having ranking order of Black (22.22%) > Brown (21.49%) > White (19.69%), with significant differences being White (9.87) > Brown (8.65) > Black (7.14) for stems. Whereas over the used seeding rates differences ; CP

contents were not significant between the 3 Bonavista bean types with different ranking order (Table, 11).

It is generally noticed that CP content of leaves for the 3 Bonavista bean types was relatively higher in the first growing season than the second one. This was not the case for CP content of their stems. Moreover, the descending ranking order of CP content was for Black (22.22), followed by Brown (21.49), then the white (19.69%) in leaves, being White (9.87), followed by Brown (8.65), then the Black (7.14%) for their stems during the first growing season with significant differences. Whereas, no significant differences in CP content were found either in their leaves or stems of the 3 Bonavista bean types (Table, 11) during the 2[nd] season. Such variations in CP contents may be due to the slight differences in their genetical specific and/or their interaction with environmental seasonal condition between the first and second growing seasons (Table, 2-b).

Results clarified that the first cut was relatively higher in CP content than the second cut in each of the 3 Bonavista bean types for their leaves and stems as compared with the second cut (Table,11). Also, Brown, Black and White types were of 23.85, 22.81 and 20.01% CP content of their leaves, respectively. Whereas, in stems the CP content was in the following descending order 10.61, 8.85 and 8.34% for White. Black and Brown types with significant differences in the first rather than in the second cuts. So, Black types was in between for CP content in either leaves (22.81) or stems (8.85) in the first cuts, whereas Brown type was of the highest CP content in leaves (23.85) and the lowest in stems (8.34) and White type was in an opposite trend of lowest CP content in leaves (20.01%) and the highest CP content in stems (10.61%). Meanwhile, the second cut did not show significant differences in CP content of the three types and in their leaves or stems, inspite of the obtained slight differences in between. Similar results were reported by **Mokoboki *et al.* (2000)**, **Jilani *et al.* (2001)**, **Valenzuela and Smith(2002)** and **Odunsi *et al.* (2003)** in Bonavista bean. Regarding seeding rates, combined analysis revealed significant differences in CP content (over the grown 3 types) according to the assigned plant population densities

of different seeding rates (Table,11).

Over the grown types of Bonavista bean, combined analysis revealed significant decrease in CP content of their leaves and stems by increasing seeding rates from 10 to 20 and up to 30kg/fed. having respective CP content of 22.16, 20.23 and 17.68% in leaves, being 9.27, 8.66 and 7.99%in stems. This trend of decreasing CP content as seeding rate increase was recorded for each of the two growing seasons and during each of the obtained cuts with significant differences and various magnitudes as well as it is clear from Table (11).

It is also noticed that there was a relative increase in CP content in leaves and stems for the first seasons than the second one and for the first cut than the second cuts. Similar results were reported by **Hintz *et al.* (1992)** in soybean and **El Karamany (2006)** in mung bean.

Results indicated significant interaction effect for Bonavista bean types and plant population densities on CP content of leaves and stems. The Black type planted at the lowest seeding rates (10 kg/fed) produced the highest leaf-CP content (25.79%) of the first cut. The same type produced the lowest CP content (12.97%) planted at seeding rates of 30 kg/fed. for the second cut. Almost similar trend was noticed for stems with similar magnitudes, where the White type produced the highest stem-CP content

(11.74%) of the first cut, planted at the lowest seeding rates (10 kg/fed). Meanwhile, Black type produced the lowest stem-CP content (6.57%) of the second cut, planted at the highest seeding rates (30 kg/fed).

Fodder Cowpea Types

Combined analysis in Table (12) presents CP content of leaves & stems for the three types of Fodder cowpea during each of the two growing seasons and cuts.

The 3 Fodder cowpea types: Fodder cowpea creamy type (FC), Fodder cowpea Brown type (FB) and Fodder cowpea Dotted type (FD) showed significant differences in their CP content over the different population densities. Leaf-CP content was in the following descending order: FD (21.91%), FB (21%) then FC (20.14%) with

Table (11): The crude protein (CP) content for leaves and stems of Bonavista bean types at various seeding rates.

Types (T)	Density (D) Kg/fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Leaves:		.... (% on dry matter basis).........................								
White	10	22.62	21.28	21.95	22.79	18.35	20.57	22.70	19.81	21.26
	20	21.18	20.23	20.61	18.84	18.35	18.59	20.01	19.19	19.60
	30	16.84	16.18	16.51	17.82	16.06	16.94	17.33	16.12	16.73
Mean		20.21	19.16	19.69	19.81	17.59	18.70	20.01	18.37	19.19
Black	10	29.83	22.62	26.23	21.75	17.54	19.65	25.79	20.08	22.93
	20	24.54	19.73	22.14	19.79	16.64	18.21	22.16	18.18	20.17
	30	22.14	14.44	18.29	18.84	11.50	15.17	20.49	12.97	16.73
Mean		25.50	18.93	22.22	20.13	15.23	17.68	22.81	17.08	19.95
Brown	10	23.58	22.62	23.10	23.72	19.25	21.48	23.65	20.93	22.29
	20	25.50	16.84	21.17	22.41	18.92	20.67	23.96	17.88	20.92
	30	25.50	14.92	20.21	22.41	15.50	18.96	23.96	15.21	19.58
Mean		24.86	18.13	21.49	22.85	17.89	20.37	23.85	18.01	20.93
10		25.34	25.51	23.76	22.75	18.38	20.56	24.05	20.27	22.16
20		23.74	20.53	21.30	20.35	17.97	19.16	22.04	18.42	20.23
30		21.49	16.85	18.34	19.69	14.36	17.02	20.59	14.76	17.68
Mean		23.52	20.86	21.13	20.93	16.90	18.91	22.23	17.82	20.02
L.S.D at: 5% for:		T=1.74 D=0.68 TD=1.18	D=0.68 TD=1.18	T=1.74 D=0.68 TD=1.18	T=2.61 D=1.03	T=2.27 D=0.89 TD=1.55	D=0.96	T=0.92 D=0.58 TD=1.01 TY=1.30 DY=0.83 TDY=1.43	D=0.53 TD=0.92 TY=1.19 DY=0.75 TDY=1.31	T=0.88 D=0.56 TD=0.97 TD=0.97 TY=1.25 TDY=1.37
Stems:										
White	10	12.51	10.11	11.31	10.96	8.70	9.83	11.74	9.41	10.57
	20	11.07	8.66	9.87	10.14	8.37	9.26	10.61	8.52	9.56
	30	9.63	7.22	8.43	9.32	7.56	8.44	9.47	7.40	8.43
Mean		11.07	8.66	9.87	10.14	8.21	9.18	10.61	8.44	9.52
Black	10	7.22	7.70	7.46	9.28	8.40	8.85	8.25	8.05	8.15
	20	7.70	7.22	7.46	8.62	7.86	8.24	8.17	7.54	7.85
	30	7.70	5.29	6.50	9.50	7.86	8.68	8.60	6.57	7.59
Mean		7.54	6.74	7.14	9.14	8.04	8.59	8.34	7.39	7.86
Brown	10	10.06	8.99	9.53	9.20	8.08	8.64	9.63	8.53	9.08
	20	9.22	8.32	8.77	8.25	8.45	8.35	8.73	8.38	8.56
	30	8.10	7.22	7.66	8.25	8.22	8.23	8.18	7.72	7.95
Mean		9.13	8.18	8.65	8.56	8.25	8.41	8.85	8.21	8.53
10		9.93	8.93	9.43	9.82	8.39	9.11	9.87	8.66	9.27
20		9.33	8.07	8.70	9.00	8.23	8.62	9.17	8.15	8.66
30		8.48	6.58	7.53	9.02	7.88	8.45	8.75	7.23	7.99
Mean		9.25	7.86	8.55	9.28	8.17	8.73	9.26	8.01	8.64
L.S.D at: 5% for:		T=2.37 D=0.71 TD=1.23	D=0.70	T=1.43 D=0.70	N.S	N.S	D=0.51	T=1.0 D=0.50 TD=0.87	D=0.43 DY=0.61	T=0.78 D=0.41 TD=0.71 DY=0.58

significant differences, whereas, stem-CP was FC (9.33%), FD (8.93%), then FB (8.90%) without significant differences. Similar significant and trend was noticed in Leaf-CP of the first season, but not for stem-CP where differences were not significant. Also, no significant differences were recorded in leaves or stems-CP content between each of the three fodder cowpeas during the second growing season.

During the first and second cuts the descending ranking order of CP content was for FD, FB, and FC with significant differences with higher CP magnitudes for the first than the second season. No significant differences were noticed for stem-CP content during the second season Tables (11 & 12). Similar results were reported by **Twidwell *et al.* (2002)** in Fodder cowpea, **Nleya and Jeranyama (2005)** in Fodder cowpea, **Ajeibe *et al.* (2008)** in Fodder cowpea and **Foster *et al.* (2009)** in Fodder cowpea.

Over the grown Fodder cowpea types, combined analysis indicated that as plant population density/feddan increased by increasing seeding rates from 15 to 30 and up to 45 kg/fed, leaf-CP and stem-CP contents significantly decreased with similar respective descending order. In other words increasing seeding rates from 15 to 30 and up to 45kg/fed caused substantial decrease in Leaf-CP content from 23.03 to 21.23 and down to 18.77%, being 10.13, 8.96 and 8.07% for stem-CP content. This trend was noticed during the first and second seasons for either leaf or stem-CP content and the first and second cuts as well with significant differences and various magnitudes as recorded in Table (12).

Results indicated significant interaction effect of Fodder cowpea types and plant population densities on CP content of leaves and stems, where the Dotted type planted at the lowest seeding rates (15 kg/fed) produced the highest leaf-CP content (25.26%) for the first cut, whereas, the same type produced the lowest CP content (16.76%), planted at highest seeding rates (45kg/fed.) for the second cut. Almost similar trend was noticed for stems with similar magnitudes, where the Creamy type produced the highest stem-CP content (11.23%) of the first cut planted at the lowest seeding rates (15 kg/fed) whereas, the same type produced the lowest CP content (7.0%) planted at

Table (12): The crude protein (CP) content for leaves and stems of Fodder cowpea types at various seeding rates.

Types (T)	Density (D) Kg/fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Leaves		.... (% on dry matter basis).......................								
Creamy	15	23.58	21.18	22.38	20.82	19.25	20.03	22.20	20.21	21.21
	30	22.14	19.73	20.93	20.44	18.68	19.56	21.29	19.20	20.25
	45	19.75	17.33	18.54	20.96	17.78	19.37	20.36	17.56	18.96
Mean		21.82	19.41	20.62	20.74	18.57	19.66	21.28	18.99	20.14
Brown	15	25.40	22.14	23.77	22.41	21.78	22.09	23.91	21.96	22.93
	30	22.69	19.25	20.97	22.12	20.07	21.10	22.41	19.66	21.03
	45	20.62	14.92	17.77	21.46	18.92	20.19	21.04	16.97	18.98
Mean		22.90	18.77	20.84	20.00	20.26	21.13	22.45	19.51	20.98
Dotted	15	28.40	28.88	28.64	22.12	20.40	21.26	25.26	24.64	24.95
	30	27.91	21.19	24.55	20.44	20.07	20.26	24.18	20.63	22.40
	45	19.42	15.40	17.41	20.59	18.11	19.35	20.00	16.76	18.38
Mean		25.24	21.82	23.53	21.05	19.53	20.29	23.15	20.67	21.91
15		25.79	24.07	24.93	21.79	20.74	21.13	23.79	22.27	23.03
30		24.25	20.06	22.16	21.0	19.61	20.30	22.63	19.83	21.23
45		19.93	15.88	17.91	21.0	18.27	19.64	20.46	18.08	18.77
Mean		23.32	20.00	21.67	21.26	19.54	20.35	22.29	20.06	21.01
L.S.D at: 5% for:		T=1.80 D=0.69 TD=1.20	T=1.74 D=0.68 TD=1.18	T=1.77 D=0.69 TD=1.19	N.S	D=0.89	D=1.05	T=0.88 D=0.66 TD=1.14 TY=1.25 DY=0.45 TDY=1.61	T=0.84 D=0.6653 TD=0.92 TY=1.25 DY=0.75 TDY=1.31	T=0.86 D=0.59 TD=1.02 TY=1.22 DY=0.84 TDY=1.45
Stems:										
Creamy	15	12.99	9.37	11.18	9.95	10.11	10.03	11.23	9.74	10.60
	30	9.15	7.22	8.18	10.20	9.21	9.70	9.67	8.22	8.94
	45	10.59	6.74	8.66	9.20	7.26	8.22	9.89	7.0	8.44
Mean		10.91	7.78	9.34	9.78	8.86	9.32	10.34	8.32	9.33
Brown	15	10.59	8.18	9.38	10.13	10.68	10.41	10.36	9.43	9.90
	30	9.63	7.70	8.66	9.57	8.65	9.11	9.60	8.18	8.89
	45	7.70	6.74	7.22	9.20	8.08	8.64	8.45	7.41	7.93
Mean		9.31	7.54	8.42	9.63	9.14	9.38	9.47	8.34	8.90
Dotted	15	10.11	8.66	9.38	11.07	9.79	10.43	10.59	9.22	9.91
	30	9.14	7.70	8.42	10.13	9.21	9.67	9.63	8.46	9.04
	45	6.74	7.22	6.98	9.57	7.83	8.70	8.15	7.52	7.84
Mean		8.34	7.86	8.26	10.26	8.94	9.60	9.46	8.40	8.93
15		11.23	8.74	9.98	10.38	10.20	10.29	10.80	9.47	10.13
30		9.31	7.54	8.42	9.96	9.03	9.49	9.63	8.28	8.96
45		8.34	6.90	7.62	9.32	7.72	8.52	8.83	7.31	8.07
Mean		9.63	7.73	8.67	9.87	8.98	9.43	9.75	8.35	9.05
L.S.D at: 5% for:		D=0.43 TD=0.75	D=0.52	D=0.41 TD=0.71	N.S	D=0.89	D=0.87	D=0.44 DY=0.69 TDY=1.20	D=0.49	D=0.46 TDY=1.12

highest seeding rates (45kg/fed.) for the second cut.

Crude fiber (CF) Content

Bonavista Bean Types

Over seeding rates results in Table (13) did not show noticeable or significant differences in crude fiber (CF) contents between the 3-grown Bonavista bean types (White, Black and Brown types) either in their leaves or stems. It could be understood that such trait is similar anther genetical makeup and/or gene expression in leaf-CP content. This result was also noticed in each of the two growing seasons and in each of the obtained cuts where the recorded differences were very narrow and of no specific trend and could be ignorable as well. However, there was consistent tendency for Brown type to be relatively higher in stem-CF than the other two types (White and Black). Also, leaves-CF was relatively higher in the second season than the first season and was almost similar in the first and second cuts of the two seasons as it is noticed from the combined analysis (Table, 13).

Regarding stems-CF content, slight ignorable differences was noticed where Brown type was higher than White type which in turn was higher than Black type. This trend was noticed during the first season and the second cuts with very slight ignorable differences (Table, 13). So, It is generally that Bonavista bean types were as follows: B > W > Br in leaves being Brown > White > Black in their stems, with slight variations within seasons and cuts as previously presented. Other results were reported by **Odunsi (2003)** in Bonavista bean.

Concerning seeding rates (over the grown Bonavista bean types) results clearly indicated that as seeding rates increased from 10 to 20 up to 30 kg/fed CF content increased from 22.23 to 24.65 and 26.84%. This trend was repeated for each of the two growing season and for each cut with significant difference either in leaves or stems with relatively higher magnitudes for stems than leaves and for the second than the first season (Table 13).

Combined analysis indicated significant interaction effect of Bonavista bean types and

Table (13): The crude fiber (CF) content for leaves and stems of Bonavista bean types at various seeding rates.

Types (T)	Density (D) Kg/fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Leaves:		.... (% on dry matter basis)........................								
White	10	17.50	18.00	17.75	26.00	28.08	27.04	21.75	23.04	22.40
	20	18.25	19.50	18.87	29.25	30.0	29.62	23.75	24.75	24.25
	30	19.50	21.00	20.25	34.00	31.25	32.62	26.75	26.12	26.44
Mean		18.42	19.50	18.96	29.75	29.78	29.76	24.08	24.64	24.36
Black	10	17.0	19.00	18.00	25.67	29.50	27.58	21.33	24.25	22.79
	20	19.0	20.25	19.62	31.50	31.50	31.50	25.75	25.87	25.56
	30	20.50	21.75	21.13	34.25	32.50	33.37	27.37	27.12	27.25
Mean		18.83	20.33	19.58	30.47	31.17	30.82	24.65	25.75	25.20
Brown	10	16.00	17.50	16.75	24.25	28.25	26.25	20.12	22.87	21.50
	20	19.50	19.50	19.50	27.75	29.75	28.75	23.67	24.67	24.12
	30	20.50	21.33	20.92	32.50	33.00	32.75	26.50	27.17	26.83
Mean		18.67	19.44	19.06	28.17	32.25	29.75	23.41	24.89	24.15
10		16.83	18.17	17.50	25.30	28.61	26.96	21.07	23.39	22.23
20		18.92	19.75	19.33	29.50	30.42	29.96	24.21	25.08	24.65
30		20.17	21.36	20.76	33.58	32.25	32.92	26.87	26.81	26.84
Mean		18.64	19.76	19.20	29.46	30.43	29.95	24.05	25.09	24.57
L.S.D at: 5% for:		D=0.69 TD=1.19	D=0.68	D=0.63	D=1.63	D=1.47	T=0.65 D=1.21	D=0.84 DY=1.18	D=0.77	T=0.38 D=0.64 DY=0.91
Stems:										
White	10	33.75	34.75	34.25	42.25	43.67	42.95	38.00	39.21	38.60
	20	35.0	37.5	36.25	43.50	46.0	44.75	39.25	41.75	40.50
	30	39.25	42.0	40.63	47.83	52.0	49.94	43.54	47.00	45.27
Mean		36.0	38.08	37.04	44.52	47.22	45.87	40.26	42.65	41.46
Black	10	32.0	33.50	32.75	45.58	40.83	43.21	38.79	37.17	37.98
	20	33.50	37.25	35.38	47.33	42.75	45.04	40.42	40.00	40.21
	30	34.0	41.0	37.50	49.67	44.42	47.04	41.83	42.71	42.27
Mean		33.17	37.25	35.21	47.53	42.67	45.10	40.35	39.96	40.15
Brown	10	32.25	38.5	35.37	40.83	43.75	42.29	36.54	41.12	38.83
	20	36.0	42.25	38.62	43.75	47.25	45.50	39.87	44.25	42.06
	30	37.25	41.50	39.37	48.50	49.83	49.17	42.87	45.67	44.27
Mean		35.17	40.42	37.79	44.36	46.94	45.65	39.76	43.68	41.72
10		32.67	35.58	34.13	42.89	42.75	42.82	37.78	39.17	38.47
20		34.83	38.67	36.75	44.86	45.33	45.10	39.85	42.00	40.92
30		36.83	41.50	39.17	48.67	48.75	48.71	42.75	45.12	43.94
Mean		34.78	38.58	36.68	45.47	45.54	46.49	40.13	42.10	41.11
L.S.D at: 5% for:		T=0.38 D=0.32 TD=0.55	T=0.65 D=0.44 TD=0.77	T=0.38 D=0.28 TD=0.49	D=2.12	T=3.33 D=1.28 TD=2.22	D=1.46	D=1.01 TY=1.57 TD=1.76	T=1.0 D=0.04 TD=1.11 TY=1.42 TDY=1.57	T=0.47 D=0.71 TD=1.22 TY=0.66

plant population densities on CF content of leaves and stems, where the Brown type planted at the highest seeding rates (30 kg/fed) produced the highest leaf-CF content (27.17%) of the second cut, whereas, the same type produced the lowest CF content (20.12%), planted at the lowest seeding rates (10 kg/fed.) for the first cut. Almost similar trend was noticed for stems, whereas, the White type produced the highest stem-CF content (47.0%) of the second cut planted at the highest seeding rates (30 kg/fed). Meanwhile, Brown type produced the lowest stem-CF content (36.54%) of the first cut planted at the lowest seeding rates (10 kg/fed).

Fodder Cowpea Types

Over seeding rates, combined analysis clarified that leaf-CF contents varied significantly according to the type of Fodder cowpea. Creamy Fodder cowpea type was of highest Leaf-CF content (28.15%), Dotted type (27.73%) and the least in Brown type (25.71) with significant differences. Similar trend was noticed in the first season and the first cuts. So, it is noticed that Creamy type Fodder cowpea was the highest in leaf-CF content (from the combined analysis) and during each of the two growing seasons as well as the first cuts. Whereas, Brown type was of the least leaf-CF content in general and each of the two seasons and during each of the first two cuts as well, but Dotted type was half-way in between in leaf-CF content.

Regarding stems-CF, it was generally noticed that such parameter was of much more values as compared with leaf-CF content. Highest, medium and lowest stem-CF content was for Brown (41.76%), Dotted (40.90%) and Creamy types (38.79%), respectively with significant differences. This result was true for the second season and each of the two cuts. Stems-CF was in the following descending order for Fodder cowpea types: Brown (41.76%) > Dotted (40.90%) > Creamy (38.79%) types, whereas for Leaf-CF it was Creamy (28.15%) > Dotted (27.73%) and Brown (25.71%) types with generally significant differences and in each of the two growing seasons and in cuts as well, with few exceptions as presented earlier for seasons and cuts. Similar results were reported by **Twidwell *et al.* (2002)**, **Nleya and Jeranyama (2005)** and **Foster *et al.* (2009)** in Fodder cowpea.

Over types, seeding rates showed significant differences in leaves & stems-CF contents within a unique pattern. Results showed that as plant population densities (over Fodder cowpea types) by increasing seeding rates from 15 to 30 and up to 45kg/fed, there was slight significant increase in Leaves & stems-CF to be 25.07, 26.83, 29.69% in leaves being 33.83, 40.35, 44.33% in stems. Similar results were recorded in each of the two seasons and cuts as presented in Table (14).

It is worth noting that the obtained increase in CF content in Fodder cowpea types as the plant population density increased by increasing seeding rates/fed could be explained by the fact that dense plants used to be of more tender stems and increasing CF content to support standing plants. Meanwhile, the close adjacent plants in a dense canopies create better convenient microenvironment especially in the hot dry summer. This situation may enhance plants for more active tender vegetative growth than expenditure its energy for survival by generating defending devices against the adverse condition through building more of the support systems as CF and lignifications. This used to be if plants were far away from each other suffering heat, dryness (evapotranspiration) and light with inferred light radiation, and soil absorbing extra of inferred radiation which may kill or deactivate the useful soil microfilaria, water and nutrient holding capacity for the sake of encouraging plant for rich proliferation of vegetative growth.

Results of the combined analysis indicated significant interaction effect of fodder cowpea types and plant population densities on CF content of leaves and stems, where the Dotted type planted at the highest seeding rates (45 kg/fed) produced the highest leaf-CF content (31.37%) of the second cut, whereas, the Brown type produced the lowest CF content (22.29%), planted at the lowest seeding rates (15kg/fed.) for the first cut. Almost similar trend was noticed for stems with more magnitudes, where the Brown type produced the highest stem-CF content (46.33%) of the second cut, planted at the highest seeding rates (45 kg/fed). Whereas, Creamy type was of the lowest CF content (34.75%), planted at seeding rates of 15kg/fed. for the first cut.

Table (14): The crude fiber (CF) content for leaves and stems of Fodder cowpea types at various seeding rates.

Types (T)	Density (D) Kg/fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Leaves:		.... (% on dry matter basis)........................								
Creamy	15	23.25	23.75	23.50	31.50	27.25	29.37	27.37	25.50	26.44
	30	24.50	25.75	25.17	32.25	29.42	30.83	28.37	27.58	27.98
	45	25.50	27.50	26.50	35.00	32.08	33.54	30.25	29.79	30.02
Mean		24.42	25.67	25.05	32.92	29.58	31.25	28.67	27.62	28.15
Brown	15	19.00	20.75	19.87	25.58	31.50	28.54	22.29	26.12	24.21
	30	20.75	21.50	21.17	25.83	32.75	29.29	23.29	27.12	25.21
	45	22.50	24.17	23.33	29.00	35.25	32.12	25.75	29.71	27.73
Mean		20.75	22.14	21.44	26.81	33.17	29.99	23.78	27.65	25.71
Dotted	15	20.50	21.50	21.00	24.25	32.00	28.12	22.37	26.75	24.56
	30	22.00	23.00	22.50	30.50	33.75	32.12	26.25	28.37	27.31
	45	23.50	27.00	25.25	39.00	35.75	37.37	31.25	31.37	31.31
Mean		22.00	23.83	22.92	31.25	33.83	32.54	26.62	28.83	27.73
15		20.92	22.00	21.46	27.11	30.25	28.68	24.01	26.12	25.07
30		22.42	23.42	22.92	29.53	31.97	30.75	25.97	27.69	26.83
45		23.83	26.22	25.08	34.33	34.36	34.35	29.08	30.29	29.69
Mean		22.39	23.88	23.15	30.32	32.19	31.26	26.35	28.03	27.20
L.S.D at: 5% for:		T=0.56 D=0.36	T=1.33 D=0.26 TD=0.45	T=0.90 D=0.27 TD=0.46	TD=1.39 TD=2.41	T=0.68 D=1.45	D=1.39 TD=2.42	T=1.78 D=0.68 TD=1.18 DY=0.96 TDY=1.67	T=0.44 D=0.70 TY=0.62	T=0.86 D=0.67 TD=1.17 TY=1.22 DY=0.95 TDY=1.65
Stems:										
Creamy	15	31.0	32.25	31.62	38.50	42.75	40.62	34.75	37.50	36.12
	30	32.50	35.50	34.0	40.0	44.00	42.00	36.25	39.75	38.00
	45	35.50	38.25	36.87	45.50	49.75	47.62	40.50	44.00	42.25
Mean		33.0	35.33	34.17	41.33	45.50	43.42	37.17	40.42	38.79
Brown	15	32.0	32.0	37.0	42.0	45.75	43.87	37.00	38.87	37.94
	30	37.25	39.25	38.25	45.75	48.25	47.00	41.50	43.75	42.62
	45	39.25	41.75	40.50	47.0	50.92	48.95	43.12	46.33	44.73
Mean		36.17	37.67	36.92	44.92	48.31	46.61	40.54	42.98	41.76
Dotted	15	36.50	39.25	37.87	39.25	42.0	40.62	37.87	40.62	39.25
	30	37.25	41.00	39.12	40.50	43.0	41.75	38.87	42.00	40.44
	45	39.50	42.25	40.87	47.0	43.25	45.12	43.25	42.75	43.00
Mean		37.75	40.83	39.29	42.25	42.75	42.50	40.00	41.79	40.90
15		33.17	34.50	33.83	39.92	43.50	41.71	36.54	39.00	37.77
30		35.67	38.58	37.18	42.08	45.08	43.58	38.87	41.83	40.35
45		38.08	40.75	39.42	46.50	47.97	47.24	42.29	44.36	43.33
Mean		35.64	37.94	36.81	42.83	45.52	44.18	39.23	41.73	40.48
L.S.D at: 5% for:		T=0.86 D=0.51 TD=0.89	T=0.22 D=0.67 TD=1.16	T=0.52 D=0.50 TD=0.87	T=2.28 D=1.74	T=3.21 D=0.56 TD=0.97	T=1.97 D=0.82 TD=1.41	T=0.72 D=0.86 TD=1.49 TY=1.02 DY=1.22 TDY=2.11	T=0.95 D=0.41 TD=0.72 TY=1.34 DY=0.58 TDY=1.01	T=0.60 D=0.45 TD=0.79 TY=0.85 DY=0.64 TDY=1.11

Ash Content

Bonavista Bean Types

As it is clear from the combined analysis (Table,15) and over the different seeding rates, ash-contents of leaves and stems for Bonavista bean types were of slight significant differences with slight ignorable variable magnitudes. However, the descending respective leaves-ash values were for Black (14.58%), White (13.67%) and Brown (13.58%), whereas, the respective stems-ash contents were for Brown (11.42%), White (10.83%) and Black type (9.83%).

It is also noticed that leaf-ash content of the Black Bonavista bean types was always of the highest significant value in each of the two seasons and their cuts. But leaf-stems values of White and Brown Bonavista bean were of very narrow range and of no specific trend. Meanwhile, stems-ash content behaved in a similar trend for each growing season and for each cut.

Over seeding rates, there was slight decline in stems-ash content in the following sequence: Brown type (11.42%), White type (10.83%) and Black type (9.83%) with slight significant differences. Such trend was repeated in each growing season and for its first cuts, whereas, during the second cuts differences between White (11.25%) and Brown (11.08%) types were quite ignorable. So, it could be noticed that Brown types was of the highest stems-ash contents, while Black type was of the lowest value in stems-ash content either over seeding rates or during the growing seasons or cuts (Table 15).

Over Bonavista bean types, increasing seeding rates caused very slightly reduction in stem-ash contents within quite ignorable levels. For 10, 20 and 30 kg seeds/fed, the respective leaves-ash contents were 14.17%, 14.04% and 13.58%, being 10.79, 10.67, 10.67% in stems. So, the increase in plant population densities did not exert appreciable differences in ash contents of Bonavista bean types. In addition, no specific trend for this studies trait was noticed within seasons or cuts.

Results indicated significant interaction effect of Bonavista bean types and plant population densities on ash content of leaves and stems, where the Black type planted at the highest seeding rates produced the highest leaf-ash content of the second cut, whereas, the White type produced the lowest ash content, planted at highest seeding rates for the second cut. Almost similar trend was noticed for stems with similar magnitudes, where the Brown type produced the highest stem-ash content of the first cut, planted at the lowest seeding rates Meanwhile, Black type produced the lowest stem-ash content of the first cut, planted at the lowest seeding rates.

Fodder Cowpea Types

Ash contents of either leaves or stems for the different types of Fodder cowpea (over the assigned seeding rates) within seasons or cuts were of lower values with narrow ranges (Table, 16).However, leaves-ash contents for Fodder cowpea types was 13.33, 13.24 and 13.00% for Dotted, Creamy and Brown type respectively, being 11.50, 11.28 and 10.92% for Brown, Dotted and Creamy types in their stem-ash content. It is also noticed the obtained leaf or ash-contents were fluctuated of no specific trend among seasons and cuts.

Concerning the effect of various seeding rates (over the studies Fodder cowpea types) on the ash contents for either leaves or stems, it was more or less of narrow ranges

without identified trend since the obtained values were fluctuated within ignorable ranges in most cases.

Results indicated slight ignorable significant interaction effect of Fodder cowpea types and plant population densities on ash content of leaves and stems, where the Dotted type planted at the highest seeding rates produced the highest leaf-ash content (14.25%) of the second cut, whereas, Creamy type produced the lowest ash content (12.42%), planted at the highest seeding rates for the second cut. Almost similar trend was noticed for stems with similar magnitudes, where the Brown type produced the highest stem-ash content (12.17%) of the second cut, planted at the medium seeding

Table (15): The Ash content for leaves and stems of Bonavista bean types at various seeding rates.

Types (T)	Density (D) Kg/fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Leaves:		.... (% on dry matter basis)								
White	10	12.00	15.00	13.50	14.00	13.00	13.50	13.00	14.00	13.50
	20	13.50	14.50	14.00	15.00	13.00	14.00	14.25	13.75	14.00
	30	13.00	13.50	13.25	15.00	12.50	13.75	14.00	13.00	13.50
Mean		12.83	14.33	13.58	14.67	12.83	13.75	13.75	13.58	13.67
Black	10	12.00	13.00	12.50	16.00	14.00	15.00	14.00	13.50	13.75
	20	13.50	14.50	14.00	16.50	14.00	15.25	15.00	14.25	14.62
	30	14.00	18.00	16.00	15.00	14.50	14.75	14.50	16.25	15.37
Mean		13.17	15.17	14.17	15.83	14.17	15.00	14.50	14.67	14.58
Brown	10	12.50	13.50	13.00	15.00	13.50	14.25	13.75	13.50	13.62
	20	12.00	14.50	13.25	15.00	12.50	13.75	13.50	13.50	13.50
	30	12.50	14.50	13.50	14.00	13.50	13.75	13.25	14.00	13.62
Mean		12.33	14.17	13.25	14.67	13.17	13.92	13.50	13.67	13.58
10		12.17	13.83	13.00	15.00	13.50	14.25	13.58	13.67	13.67
20		13.00	14.50	13.75	15.50	13.17	14.33	14.25	13.83	14.04
30		13.17	15.33	14.25	14.67	13.50	14.08	13.92	14.42	14.17
Mean		12.78	14.55	13.67	15.05	13.39	14.22	13.92	13.97	13.96
L.S.D at: 5% for:		T=0.58 D=0.38 TD=0.66	T=0.35 D=0.17	T=0.47 D=0.21 TD=0.36	T=0.78	TD=0.72	T=0.29	T=0.29	T=0.36 D=0.23 TD=0.40 DY=0.32 TDY=0.56	T=0.16 D=0.34 TD=0.53 TY=0.23 DY=0.44 TDY=0.76
Stems:										
White	10	10.00	11.50	10.75	10.00	10.50	10.25	10.00	11.00	10.50
	20	11.00	11.50	11.25	10.50	12.00	11.25	10.75	11.75	11.25
	30	10.50	10.50	10.50	10.50	11.50	11.00	10.50	11.00	10.75
Mean		10.50	11.17	10.83	10.33	11.33	10.83	10.42	11.25	10.83
Black	10	9.50	10.00	9.75	8.50	10.50	9.50	9.00	10.25	9.62
	20	11.00	9.00	10.00	9.50	10.00	9.75	10.25	9.50	9.87
	30	10.50	10.00	10.25	10.00	9.50	9.75	10.25	9.75	10.00
Mean		10.33	9.67	10.00	9.33	10.00	9.67	9.83	9.83	9.83
Brown	10	11.50	11.00	11.25	12.50	12.00	12.25	12.00	11.50	11.75
	20	10.50	11.00	10.75	12.00	11.50	11.75	11.25	11.25	11.25
	30	11.00	10.50	10.75	13.00	10.50	11.75	12.00	10.50	11.25
Mean		11.00	10.83	10.92	12.50	11.33	11.92	11.75	11.08	11.42
10		10.33	10.83	10.58	10.33	11.00	10.67	10.33	10.92	10.67
20		10.83	10.50	10.67	10.67	11.17	10.92	10.75	10.83	10.79
30		10.67	10.33	10.50	11.17	10.50	10.83	10.92	10.42	10.67
Mean		10.61	10.55	10.58	10.72	10.89	10.81	10.67	10.72	10.71
L.S.D at: 5% for:		T=0.22 D=0.30 TD=0.51	T=0.58 D=0.17 TD=0.30	T=0.19 D=0.12 TD=0.21	T=0.38 D=0.38 TD=0.66	TD=1.06	T=0.85 TD=0.66	T=0.13 D=0.23 TD=0.40 TY=0.18 DY=0.23	T=0.49 D=0.30 TD=0.53 TDY=0.74	T=0.26 TD=0.33 TY=0.36

rates. Whereas, Creamy type produced the lowest ash content (10.0%), planted at the highest seeding rates for the first cut.

So, it could be concluded that difference in leaves and stems-ash contents were not appreciably affected by the grown Fodder cowpeas type or seeding rates under the circumstances of this study further investigation in this respect is advisable.

Ether Extract (EE) Content

Bonavista Bean and Fodder Cowpea Types

It is clear from Tables (17&18) that the range of EE is very narrow and did not show noticeable response for any of the investigated factors under study or on its impact on EE for either leaves or stems for any of the studied Bonavista bean or Fodder cowpea types. This is a real fact inspite of the presence some significant difference, where, the obtained results were fluctuated of no specific trend for types, seasons and cuts under the circumstances of the study. These results match with those of **Twidwell *et al.* (2002)** in Fodder cowpea and **Odunsi (2003)** in Bonavista bean.

Nitrogen Free Extract (NFE) Content

Data in Tables (19&20) present the combined analysis for the studied native herbaceous legumes of Bonavista bean and Fodder cowpea types planted at various plant population densities.

Bonavista Bean Types

Over seeding rates, Bonavista bean types varied significantly with relatively narrow range values in their leaf and stem-NFE content. Results indicated that the highest and lowest-NFE values for leaves were noticed for White (W) and Black (B) types of Bonavista bean, respectively. Leaf-NFE contents were 37.96, 36.52 and 35.74% for White, Brown and Black respectively. Whereas for stems-NFE contents, it was 39.44, 35.71 and 35.57% for Black, Brown_and White, respectively. Such variations could be a specific identify of these studied types as affectedly with the prevailing conditions under the circumstances of this study.

Table (16): The ash content for leaves and stems of Fodder cowpea types at various seeding rates.

Types (T)	Density (D) Kg/fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Leaves:		………………… (% on dry matter basis)…………………								
Creamy	15	12.00	13.50	12.75	16.00	13.00	14.50	14.00	13.25	13.62
	30	10.50	13.50	12.00	16.50	12.50	14.50	13.50	13.00	13.25
	45	11.00	12.50	11.75	15.50	12.33	13.92	13.25	12.42	12.83
Mean		11.17	13.17	12.17	16.00	12.61	14.31	13.58	12.89	13.24
Brown	15	13.00	14.00	13.50	13.50	13.00	13.25	13.25	13.50	13.37
	30	12.00	12.50	12.25	13.50	12.50	13.00	12.75	12.50	12.62
	45	11.50	12.50	12.00	14.50	13.50	14.00	13.00	13.00	13.00
Mean		12.17	13.00	12.58	13.83	13.00	13.42	13.00	13.00	13.00
Dotted	15	12.50	13.00	12.75	15.00	13.00	14.00	13.75	13.00	13.37
	30	11.00	14.00	12.50	14.50	12.50	13.50	12.75	13.25	13.00
	45	11.50	15.00	13.25	14.50	13.50	14.00	13.00	14.25	13.62
Mean		11.67	14.00	12.83	14.67	13.00	13.83	13.17	13.50	13.33
15		12.50	13.50	13.00	14.83	13.00	13.92	13.67	13.25	13.46
30		11.17	13.33	12.25	14.83	12.50	13.67	13.00	12.92	12.96
45		11.33	13.33	12.33	14.83	13.11	13.97	13.08	13.22	12.33
Mean		11.67	13.39	12.53	14.83	12.87	13.85	13.25	13.13	12.92
L.S.D at: 5% for:		T=0.22 D=0.30	TD=0.66	T=0.39 D=0.23 TD=0.39	T=0.95	N.S	N.S	T=0.29 TY=0.41	T=0.39 TD=0.72 TDY=1.02	D=0.40 TY=0.41
Stems:										
Creamy	15	10.50	10.50	10.50	11.50	13.00	12.25	11.00	11.75	11.37
	30	11.50	9.50	10.50	10.00	11.50	10.75	10.75	10.50	10.62
	45	11.50	10.50	11.00	8.50	12.50	10.50	10.00	11.50	10.75
Mean		11.17	10.17	10.67	10.00	12.33	11.17	10.58	11.25	10.92
Brown	15	12.00	10.50	11.25	11.00	12.83	11.92	11.50	11.67	11.58
	30	11.50	11.00	11.25	10.50	13.33	11.92	11.00	12.17	11.58
	45	11.00	10.00	10.50	10.50	13.83	12.17	10.75	11.92	11.33
Mean		11.50	10.50	11.00	10.67	13.33	12.00	11.08	11.92	11.50
Dotted	15	11.50	9.00	10.25	11.50	13.00	12.25	11.50	11.00	11.25
	30	11.50	10.00	10.75	11.00	12.83	11.92	11.25	11.42	11.33
	45	10.00	11.00	10.50	11.00	13.00	12.00	10.50	12.00	11.25
Mean		11.00	10.00	10.50	11.17	12.94	12.06	11.08	11.47	11.28
15		11.33	10.00	10.67	11.33	12.94	12.14	11.33	11.47	11.40
30		11.50	10.17	10.83	10.50	12.55	11.53	11.00	11.36	11.18
45		10.83	10.50	10.67	10.00	13.11	11.56	10.42	11.81	11.11
Mean		11.22	10.22	10.72	10.61	12.86	11.74	10.92	11.55	11.23
L.S.D at: 5% for:		T=0.38 D=0.24 TD=0.42	TD=0.89	T=0.38 TD=0.42	T=0.22	N.S	T=0.57	T=0.13 D=0.54 TY=0.18 TDY=1.33	T=0.38 TD=0.81	T=0.20 TY=0.28 TDY=1.01

Table (17): The ether extract (EE) content for leaves and stems of Bonavista bean types at various seeding rates.

Types (T)	Density (D) Kg/fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Leaves:		.... (% on dry matter basis).....................								
White	10	5.00	3.70	4.35	5.15	5.10	5.12	5.07	4.40	4.74
	20	5.70	4.00	4.85	4.90	4.60	4.75	5.30	4.30	4.80
	30	5.80	5.00	5.40	4.45	4.45	4.45	5.12	4.72	4.92
Mean		5.50	4.23	4.87	4.83	4.72	4.77	5.17	4.47	4.82
Black	10	4.95	3.60	4.27	4.50	4.75	4.62	4.72	4.17	4.45
	20	5.00	3.70	4.35	4.35	4.70	4.52	4.67	4.20	4.44
	30	5.50	4.20	4.85	4.50	4.65	4.57	5.00	4.42	4.71
Mean		5.15	3.83	4.49	4.45	4.70	4.57	4.80	4.27	4.53
Brown	10	5.10	4.90	5.00	4.40	4.70	4.55	4.75	4.80	4.77
	20	5.20	5.00	5.10	4.50	4.45	4.47	4.85	4.72	4.79
	30	5.40	5.00	5.20	4.65	4.40	4.52	5.02	4.70	4.86
Mean		5.23	4.97	5.10	4.52	4.52	4.52	4.87	4.74	4.81
10		5.02	4.07	4.54	4.68	4.85	4.77	4.85	4.46	4.65
20		5.30	4.23	4.77	4.58	4.58	4.58	4.94	4.41	4.67
30		5.23	4.73	5.15	4.53	4.50	4.52	5.05	4.62	4.83
Mean		5.18	4.34	4.82	4.60	4.64	4.62	4.95	4.50	4.72
L.S.D at: 5% for:		T=0.21 D=0.15 TD=0.27	T=0.64 D=0.18 TD=0.32	T=0.25 D=0.13 TD=0.22	T=0.23	T=0.17 D=0.15	T=0.08 D=0.12 TD=0.21	T=0.09 D=0.15 DY=0.21 TDY=0.36	T=0.20 D=0.11 TD=0.20 TY=0.28 DY=0.16 TDY=0.28	T=0.08 D=0.08 TY=0.11 DY=0.12 TDY=0.20
Stems:										
White	10	2.50	2.20	2.35	2.95	2.45	2.70	2.78	2.48	2.63
	20	2.50	2.45	2.48	2.80	2.25	2.52	2.70	2.47	2.59
	30	2.60	2.70	2.65	2.80	2.20	2.50	2.72	2.55	2.63
Mean		2.53	2.45	2.49	2.85	2.30	2.58	2.73	2.50	2.62
Black	10	3.00	2.00	2.50	2.65	2.40	2.53	3.07	2.40	2.73
	20	3.20	2.15	2.68	2.70	2.60	2.65	3.03	2.42	2.73
	30	3.20	2.25	2.73	3.05	2.65	2.85	3.00	2.36	2.68
Mean		3.13	2.13	2.63	2.80	2.55	2.68	3.03	2.39	2.71
Brown	10	2.35	2.20	2.28	2.95	2.80	2.88	2.69	2.55	2.62
	20	2.70	2.40	2.55	2.80	2.70	2.75	2.78	2.60	2.69
	30	2.70	2.40	2.55	2.60	2.45	2.53	2.63	2.50	2.57
Mean		2.58	2.33	2.46	2.78	2.65	2.71	2.70	2.55	2.63
10		2.62	2.13	2.38	2.85	2.55	2.70	2.85	2.48	2.66
20		2.80	2.33	2.57	2.77	2.52	2.65	2.84	2.50	2.67
30		2.83	2.45	2.64	2.82	2.43	2.63	2.78	2.47	2.63
Mean		2.75	2.30	2.53	2.81	2.50	2.66	2.82	2.48	2.65
L.S.D at: 5% for:		T=0.35 D=0.17	T=0.23 D=0.13	D=0.06	TD=0.20	T=0.02 D=0.08 TD=0.14	D=0.09	T=0.14 TD=0.18 TY=0.21	TY=0.17 DY=0.12	DY=0.07

Table (18): The ether extract (EE) content for leaves and stems of Fodder cowpea types at various seeding rates.

Types (T)	Density (D) Kg/fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Leaves:		……………………. (% on dry matter basis)…………………….								
Creamy	15	5.90	5.30	5.60	6.75	5.35	6.05	6.32	5.32	5.82
	30	6.15	5.30	5.72	6.85	5.25	6.05	6.50	5.27	5.89
	45	6.50	5.50	6.00	6.90	4.90	5.90	6.70	5.20	5.95
Mean		6.18	5.37	5.77	6.83	5.17	6.00	6.51	5.27	5.89
Brown	15	6.15	4.50	5.32	5.75	4.95	5.35	5.95	4.72	5.34
	30	6.50	4.90	5.70	5.90	4.90	5.40	6.20	4.90	5.55
	45	6.83	5.10	5.97	6.15	4.95	5.55	6.49	5.02	5.76
Mean		6.49	4.83	5.66	5.93	4.93	5.43	6.21	4.88	5.55
Dotted	15	5.70	5.30	5.50	5.50	4.70	5.10	5.60	5.00	5.30
	30	6.50	5.50	6.00	5.75	4.80	5.27	6.12	5.15	5.64
	45	6.50	5.60	6.05	6.05	5.15	5.60	6.27	5.37	5.82
Mean		6.23	5.47	5.85	5.70	4.88	5.32	6.00	5.17	5.59
15		5.92	5.03	5.47	6.00	5.00	5.50	5.96	5.02	5.49
30		6.38	5.23	5.81	6.17	4.98	5.57	6.27	5.11	5.69
45		6.61	5.40	6.00	6.37	5.00	5.68	6.49	5.20	5.84
Mean		6.30	5.22	5.76	6.18	4.99	5.58	6.24	5.11	5.67
L.S.D at: 5% for:		D=0.25	T=0.19 D=0.19	D=0.13	T=0.16 D=0.29	T=0.22	T=0.13	T=0.11 D=0.18 TY=0.15	T=0.08 TY=0.12 DY=0.21	T=0.08 D=0.14 TY=0.11 DY=0.20
Stems:										
Creamy	15	2.80	2.20	2.50	3.35	2.55	2.95	3.02	2.39	2.70
	30	3.00	2.40	2.70	3.00	2.98	2.99	2.95	2.40	2.67
	45	3.00	2.50	2.75	2.90	2.90	2.90	2.93	2.42	2.68
Mean		2.93	2.37	2.65	3.08	2.81	2.96	2.97	2.41	2.69
Brown	15	2.90	2.50	2.70	3.45	2.60	3.02	3.13	2.58	2.86
	30	2.95	2.60	2.77	3.30	2.75	3.02	3.04	2.62	2.83
	45	3.05	2.60	2.82	3.10	2.75	2.92	3.00	2.53	2.77
Mean		2.97	2.57	2.77	3.28	2.70	2.99	3.06	2.58	2.82
Dotted	15	3.30	2.30	2.80	3.40	2.80	3.10	3.31	2.52	2.91
	30	3.20	2.40	2.80	3.15	2.72	2.93	3.14	2.52	2.83
	45	3.20	2.40	2.80	2.80	2.65	2.72	3.02	2.42	2.72
Mean		3.23	2.37	2.80	3.12	2.72	2.92	3.16	2.48	2.82
15		3.00	2.33	2.67	3.40	2.65	3.02	3.16	2.50	2.82
30		3.05	2.47	2.76	3.15	2.82	2.98	3.04	2.51	2.78
45		3.08	2.50	2.79	2.93	2.77	2.85	2.98	2.46	2.72
Mean		3.04	2.43	2.74	3.16	2.75	2.96	3.06	2.49	2.77
L.S.D at: 5% for:		T=0.22	T=0.16 D=0.08	T=0.04 D=0.05 TD=0.08	D=0.08 TD=0.14	N.S	D=0.04 TD=0.08	T=0.09 D=0.07 TY=0.13 DT=0.10	T=0.08 D=0.05 DY=0.06	T=0.04 D=0.03 TD=0.05 TY=0.05 DY=0.04 TDY=0.07

The above descending ranking order for leaves-NFE values was White > Brown > Black. It was noticed with variable magnitudes during each of the first and second growing seasons and their first and second cuts as well with slight significant differences except for the second cuts where such trend did not reach the level of significance.

It is also noticed that Black type was significantly the highest in stems-NFE contents in the first and second growing seasons and in the first and second cuts as well with significant differences except the first cut where differences die not reach the level of significance.

So, it could be concluded that the highest leaves-NFE contents were recorded in White type of Bonavista bean and the lowest value was noticed in Black type. Whereas, the highest stem-NFE contents was for Black, followed by Brown then White Bonavista bean types.

This trend was noticed during the first and second growing seasons and during each cut of the two seasons. These results match those of **Twidwell *et al.* (2002)** in Fodder cowpea and **Odunsi (2003)** in Bonavista bean.

Over types, seeding rate did not follow specific trend in its effect on the NFE content of leaves. Whereas, stem-NFE were decreased as seeding rate significantly increased (Table, 19). This trend was not noticed during the two seasons and their cuts with significant differences.

Results indicated significant interaction effect of Bonavista bean types and plant population densities for NFE content of leaves and stems, where the White type planted at the highest seeding rates produced the highest leaf-NFE content of the second cut, whereas, the Brown type produced the lowest NFE content planted at the highest seeding rates for the first cut. Almost similar trend was noticed for stems, where the Black type produced the highest stem-NFE content of the second cut planted at the lowest seeding rates. Meanwhile, White type produced the lowest stem-NFE content of the second cut planted at the highest seeding rates.

Table (19): The nitrogen free extract (NFE) content for leaves and stems of Bonavista bean types at various seeding rates.

Types (T)	Density (D) Kg/fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1[st] cut	2[nd] cut	Mean	1[st] cut	2[nd] cut	Mean	1[st] cut	2[nd] cut	Mean
Leaves:		.... (% on dry matter basis)								
White	10	42.88	42.02	42.45	32.06	35.47	33.77	37.48	38.74	38.11
	20	41.37	41.97	41.67	32.01	34.05	33.03	36.69	38.01	37.35
	30	44.86	44.32	44.59	28.73	35.73	32.23	36.80	40.03	38.41
Mean		43.04	42.77	42.90	30.97	35.09	33.01	36.97	38.93	37.96
Black	10	36.22	41.78	39.00	32.08	34.21	33.15	34.15	38.00	36.07
	20	37.96	41.82	39.89	27.86	33.16	30.51	32.91	37.49	35.20
	30	37.86	41.61	39.74	27.41	36.85	32.13	32.63	39.23	35.93
Mean		37.35	41.74	39.54	29.12	34.74	31.93	33.23	38.24	35.74
Brown	10	42.82	41.48	42.15	32.63	34.30	33.47	37.73	37.89	37.81
	20	37.80	44.16	40.98	30.34	34.38	32.36	34.07	39.27	36.67
	30	36.10	44.25	40.17	26.44	33.60	30.02	31.27	38.92	35.09
Mean		38.91	43.30	41.10	29.81	34.09	31.95	34.36	38.69	36.52
10		40.64	41.76	41.20	32.26	34.66	33.46	36.45	38.21	37.33
20		39.04	42.65	40.85	30.07	33.86	31.97	34.56	38.26	36.41
30		39.61	43.39	41.50	27.53	35.40	31.46	33.57	39.39	36.48
Mean		39.76	42.60	41.18	29.95	34.64	32.30	34.86	38.62	36.74
L.S.D at: 5% for:		T=1.92 D=0.92 TD=1.60	D=1.07 TD=1.85	TD=1.69	D=2.12	N.S	D=1.54	T=1.63 D=1.11 TD=1.92 DY=1.57 TDY=2.72	N.S	T=1.16 TD=1.50 DY=1.22
Stems:										
White	10	41.24	41.18	41.34	33.72	34.37	34.04	37.48	37.90	37.69
	20	40.43	39.89	40.16	32.96	31.13	32.04	36.69	35.51	36.10
	30	38.02	37.58	37.80	29.51	26.54	28.02	33.77	32.06	32.91
Mean		39.90	39.64	39.77	32.06	30.68	31.37	35.98	35.16	35.57
Black	10	48.28	46.80	47.54	33.50	37.46	35.48	40.89	42.13	41.51
	20	44.60	44.38	44.49	31.67	36.69	34.18	38.14	40.54	39.34
	30	44.60	41.46	43.03	28.03	35.76	31.90	36.32	38.61	37.46
Mean		45.83	44.21	45.02	31.07	36.64	33.85	38.45	40.42	39.44
Brown	10	43.84	39.31	41.57	34.44	33.27	33.86	39.14	36.29	37.71
	20	41.58	37.03	39.31	33.13	30.00	31.57	37.36	33.52	35.44
	30	40.95	38.38	39.66	27.68	28.85	28.77	34.31	33.52	33.96
Mean		42.12	38.24	40.18	31.75	30.71	31.23	36.94	34.47	35.71
10		44.45	42.52	43.49	33.88	35.03	34.46	39.17	38.77	38.98
20		42.20	40.43	41.32	32.59	32.61	32.60	37.40	36.52	36.96
30		41.19	39.14	40.16	28.41	30.38	29.40	34.80	34.76	34.78
Mean		42.61	40.70	41.66	31.63	32.67	32.15	37.12	36.58	36.91
L.S.D at: 5% for:		T=2.47 D=1.10	T=1.33 D=1.16 TD=2.00	T=1.71 D=1.02	D=2.39	T=3.30 D=1.19 TD=2.06	T=1.78 D=1.59	D=1.25 TY=2.20 DY=1.77	T=1.05 D=0.79 TD=1.36 TDY=1.93	T=0.73 D=0.40 TY=1.03 DY=1.27

Fodder Cowpea Types

Fodder cowpea types were of significant differences in their leaf-NFE contents. Whereas, Brown types of the highest leaf-NFE. While Creamy and Dotted types were of similar NFE contents. Such trend was noticed during the two growing seasons but not during the cuts. However, the Creamy type was of the highest stem-NFE contents significantly, while, Dotted and Brown types were or almost similar in stem-NFE content. Such trend was recorded during the second season and the two cuts.

Over the grown Fodder cowpea types, seeding rates did not show wide (33.26 - 32.82%) significant differences in their leaf-NFE contents, whereas, stems-NFE showed slight significance decrease as seeding rates increased from 15 to 30 up to 45kg/fed. where the respective leaf-NEF was 37.87, 36.73 and 34.77%. such slight significant decrease in Leaf-NEF was noticed during the first and second growing seasons and for each of the cuts whereas in the second cuts differences did not reach the level of significant level. However, such trend was noticed for stem-NEF contents during each season and each cut with slight significant differences of various magnitudes (Table 20).This result could be due to the shorter leafy nature of plants which have better even distribution of light trapping devices.

Results indicated significant interaction effect of Fodder cowpea types and plant population densities on NFE content of leaves and stems, where, Creamy type planted at the highest seeding rates produced the highest leaf-NFE content for the first cut, whereas, Brown type produced the lowest NFE content planted at the lowest seeding rates for the second cut. Almost similar trend was noticed for stems with lower magnitudes where the Creamy type produced the highest stem-NFE content of the first cut planted at the medium seeding rates and Brown type produced the lowest NFE content planted at the highest seeding rates for the second cut.

Total Digestible Nutrients (TDN) Content

Bonavista bean types

Data in Table (21) present the total digestible nutrients (TDN) of Bonavista bean types as affected by different seeding rates. Results over the seeding rates and the combined analysis indicated that Brown_Bonavista bean type was significantly higher in the TDN as compared with the other two types (White and Black types). This trend was noticed during each of the two growing seasons and their first cuts. The respect TDN was 64.12, 63.36 and 63.01% for Brown, White and_Black type, respectively for leaves. Whereas, stems acted in an opposite trend concerning their TDN than leaves previously presented, where Black type was of the highest values, followed by White then Brown type containing 47.87, 47.50 and 46.96%, respectively. Similar behaviour was noticed during the two seasons and the second cut. It could be concluded that the lowest values of TDN were for Black type in leaves and for the Brown type in stems. Similar results were reported by **Valenzuela and Smith (2002)** in Bonavista bean, **Odunsi (2003)** in Bonavista bean and **Foster *et al.* (2009)** in Fodder cowpea.

The highest TDN values for White Bonavista bean type could be due to the lack of phenolic materials that is concentrated on the seed-coat for the Brown and Black types, and could be widely diluted and distributed in the above areal portion (foliage) of plants. Such phenolic materials may cause lack of digestibility for its well known functions in this respect.

Regarding seeding rates, it is obviously clear from the combined analysis that the TDN of leaves and stems of Bonavista bean type (over the types) decreased as seeding rates increased from 10 to 20 and up to 30kg/fed respectively. The respective TDN values were 65.96, 63.52 and 61.02% for leaves, being 49.59, 47.59 and 45.15% for stems. Significant interaction effect of Bonavista bean types and plant population densities for TDN content of leaves and stems was noticed, where the Brown type planted at the lowest seeding rates produced the highest leaf-TDN content of the first cut, whereas,

Table (20): The nitrogen free extract (NFE) content for leaves and stems of Fodder cowpea types at various seeding rates.

Types (T)	Density (D) Kg/fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Leaves :		.... (% on dry matter basis)								
Creamy	15	35.27	36.27	35.77	24.93	35.15	30.04	30.10	35.71	32.91
	30	36.71	35.72	36.21	23.96	34.16	29.05	30.33	34.94	32.64
	45	37.25	37.17	37.21	21.64	32.90	27.27	29.44	35.03	32.24
Mean		36.41	36.39	36.40	23.51	34.07	28.79	29.96	35.23	32.59
Brown	15	36.45	38.61	37.53	32.76	28.77	30.76	34.60	33.69	34.15
	30	38.06	41.85	39.96	32.64	29.78	31.21	35.35	35.82	35.58
	45	38.55	43.31	40.93	28.89	27.38	28.13	33.72	35.35	34.53
Mean		37.69	41.26	39.48	31.43	28.64	30.04	34.55	34.95	34.75
Dotted	15	32.90	31.32	32.11	33.13	29.90	31.51	33.01	30.61	31.81
	30	32.59	36.31	34.45	28.81	28.88	28.84	30.70	32.60	31.65
	45	39.08	37.00	38.04	19.86	27.49	23.67	29.47	32.24	30.81
Mean		34.85	34.88	34.87	27.26	28.76	28.01	31.06	31.82	31.44
15		34.87	35.40	35.14	30.27	31.23	30.77	32.57	33.34	32.96
30		35.79	37.96	36.87	28.47	30.94	29.70	32.13	34.45	33.26
45		38.29	39.16	38.73	23.46	29.25	26.36	30.88	34.21	32.54
Mean		36.32	37.51	36.91	27.40	30.49	28.94	31.86	34.00	32.92
L.S.D at: 5% for:		T=0.36 D=0.68 TD=1.19	T=1.05 D=0.49 TD=0.85	T=1.18 D=0.98 TD=1.69	D=1.94 TD=3.37	T=2.20	D=2.16	T=2.60 D=1.10 DY=1.55 TDY=2.69	T=0.70 TY=0.99 DY=1.85	T=1.63 DY=1.59 TDY=2.75
Stems:										
Creamy	15	42.71	45.68	44.20	36.82	31.55	34.19	39.77	38.62	39.19
	30	43.85	45.38	44.62	36.91	32.89	34.90	40.38	39.13	39.76
	45	39.41	42.01	40.71	33.94	28.14	31.04	36.67	35.08	35.88
Mean		41.99	44.36	43.17	35.89	30.86	33.37	38.94	37.61	38.27
Brown	15	42.51	46.82	44.66	33.51	28.06	30.78	38.00	37.44	37.72
	30	38.67	39.45	39.06	31.05	27.11	29.09	34.86	33.28	34.07
	45	39.00	38.91	38.96	30.36	24.71	27.53	34.68	31.81	33.24
Mean		40.06	41.73	40.86	31.64	26.63	29.13	35.85	34.18	35.01
Dotted	15	38.59	40.79	39.69	34.86	32.48	33.67	36.73	36.63	36.68
	30	38.91	38.90	38.91	35.29	32.32	33.81	37.10	35.61	36.36
	45	40.56	37.13	38.84	29.60	33.49	31.54	35.08	35.31	35.19
Mean		39.35	38.94	39.15	33.25	32.76	33.00	36.30	35.85	36.08
15		41.27	44.43	42.85	35.06	30.70	32.88	38.17	37.56	37.87
30		40.48	41.24	40.86	34.41	30.77	32.59	37.45	36.00	36.73
45		39.66	39.35	39.50	31.30	28.78	30.04	35.48	34.06	34.77
Mean		40.47	41.67	41.07	33.59	30.08	31.84	37.03	35.87	36.46
L.S.D at: 5% for:		D=0.70 TD=1.21	T=0.89 D=0.81 TD=1.40	T=1.54 D=0.55 TD=0.96	T=0.79 D=2.13	T=3.22 D=1.12 TD=1.94	T=1.54 D=1.26	T=0.82 D=1.06 TD=1.84 TDY=2.60	T=0.98 D=0.65 TD=1.132 TY=1.39 DY=0.92 TDY=1.60	T=0.64 D=0.65 TD=1.13 TY=0.91 DY=0.92

the Brown type produced the lowest TDN content planted at the highest seeding rates for the second cut. Almost similar trend was noticed for stems with similar relatively lower values, where the Brown type produced the highest stem-TDN content of the first cut planted at the lowest seeding rates and White type produced the lowest stem-TDN content of the second cut, planted at the highest seeding rates with slight significant differences (Table 21).

Fodder Cowpea Types

Over seeding rates, the combined analysis showed that the Brown cowpea type has significantly the highest TDN content in leaves (63.00%) and the lowest level in stems (47.06%). An opposite trend was noticed for Creamy type which has the highest level in stems (49.38%) and the lowest values of TDN in leaves (60.93%). The superiority of TDN content for Brown cowpea type was recorded during seasons and cuts. Similar trend of creamy type behavior was noticed in the first season and each of the two cuts.

The highest TDN values for White Bonavista bean type could be due to the lack of phenolic materials that is concentrated on the seed-coat for the Brown and Black types, and could be widely diluted and distributed in the above areal portion (foliage) of plants. Such phenolic materials may caused lack of digestibility for its well known functions in this respect.

Regarding the response of seeding rates (over types), it is obviously clear that as the population density of plants increased by increasing seeding rates of Fodder cowpea from 15 to 30 and up to 45 kg/fed, the obtained TDN decreased with slight significant differences. This pattern was noticed in general for cowpea types and during each season and their cuts as well, Table (22).

From the combined analysis, results indicated significant interaction effect of Fodder cowpea types and plant population densities for TDN content of leaves and stems, where the Dotted type planted at the lowest seeding rates produced the highest leaf-TDN content of the first cut, whereas, the same type produced the lowest TDN content planted at the highest seeding rates for the second cut. Whereas, the Creamy type

Table (21):The total digestible nutrients (TDN) content for leaves and stems of Bonavista bean types at various seeding rates.

Types (T)	Density (D) Kg/fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Leaves:		.... (% on dry matter basis).........................								
White	10	69.57	68.74	69.16	63.43	60.35	61.89	66.50	64.55	65.52
	20	68.52	67.21	67.86	59.67	58.95	59.32	64.10	63.08	63.59
	30	66.09	64.76	65.43	55.85	57.24	56.54	60.97	61.00	60.98
Mean		68.06	66.90	67.48	59.65	58.85	59.25	63.85	62.87	63.36
Black	10	72.46	68.48	70.47	63.31	59.03	61.17	67.88	63.76	65.82
	20	69.15	66.55	67.85	58.36	57.26	57.81	63.75	61.91	62.83
	30	67.21	63.61	65.41	56.02	54.73	55.38	61.62	59.17	60.39
Mean		69.61	66.21	67.91	59.23	57.01	58.12	64.42	61.61	63.01
Brown	10	71.00	69.57	70.29	65.03	60.55	62.79	68.01	65.06	66.54
	20	69.12	66.09	67.61	62.02	59.34	60.68	65.57	62.71	64.14
	30	68.39	64.08	66.23	58.55	55.77	57.16	63.47	59.92	61.70
Mean		69.50	66.58	68.04	61.86	58.55	60.71	65.68	62.56	64.12
10		71.01	68.93	69.97	63.92	59.98	61.95	67.47	64.45	65.96
20		68.93	66.62	67.77	60.01	58.52	59.77	64.47	62.57	63.52
30		67.23	64.15	65.69	56.81	55.91	56.36	62.02	60.03	61.02
Mean		69.05	66.57	67.81	60.25	58.14	59.36	64.65	62.35	63.50
L.S.D at: 5% for:		T=0.98 D=0.57 TD=0.99	T=0.22 D=0.58	T=0.40 D=0.54	T=1.18 D=1.40	D=0.99	T=1.01 D=0.97	T=0.45 D=0.72 TY=0.64 DY=0.72	D=0.54	T=0.32 D=0.53 TY=0.45 DY=0.74
Stems:										
White	10	54.17	52.60	53.39	47.43	45.60	46.51	50.80	49.10	49.95
	20	52.76	50.09	51.42	46.23	43.78	45.00	49.49	46.93	48.21
	30	49.15	46.30	47.72	42.77	39.12	40.95	45.96	42.71	44.33
Mean		52.02	49.66	50.84	45.48	42.83	44.15	48.75	46.25	47.50
Black	10	53.60	52.67	53.13	44.40	47.56	45.98	49.00	50.12	49.56
	20	52.67	49.76	51.22	42.90	45.97	44.43	47.78	47.87	47.83
	30	52.31	46.35	49.33	41.50	44.76	43.13	46.90	45.55	46.23
Mean		52.86	49.60	51.23	42.93	46.10	44.52	47.90	47.85	47.87
Brown	10	54.41	49.47	51.94	47.84	45.32	46.58	51.12	47.40	49.26
	20	51.38	47.23	49.30	45.38	42.90	44.14	48.38	45.07	46.72
	30	50.07	46.66	48.37	41.91	40.93	41.42	45.99	43.80	44.89
Mean		51.96	47.79	49.87	45.04	43.05	44.05	48.50	45.42	46.96
10		54.06	51.58	52.82	46.56	46.16	46.36	50.31	48.87	49.59
20		52.27	49.03	50.65	44.83	44.22	44.53	48.55	46.62	47.59
30		50.51	46.44	48.47	42.06	41.60	41.83	46.28	44.02	45.15
Mean		52.28	49.02	50.65	44.48	43.99	44.24	48.38	46.50	47.44
L.S.D at: 5% for:		D=0.26 TD=0.44	T=0.95 D=0.24 TD=0.42	T=0.91 D=0.17 TD=0.29	D=1.55	T=2.26 D=1.05 TD=1.82	D=1.10	D=0.75 TD=1.29 TY=1.22	T=0.72 D=0.51 TD=0.88 TY=1.02 TDY=1.26	T=0.44 D=0.52 TD=0.74

Table (22): The total digestible nutrients (TDN) content for leaves and stems of Fodder cowpea types at various seeding rates.

Types (T)	Density (D) Kg/fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1[st] cut	2[nd] cut	Mean	1[st] cut	2[nd] cut	Mean	1[st] cut	2[nd] cut	Mean
Leaves:		........................(% on dry matter basis)........................								
Creamy	15	65.71	64.51	65.11	58.72	61.28	60.00	62.22	62.89	62.55
	30	64.29	62.54	63.42	58.04	59.49	58.77	61.17	61.01	61.09
	45	62.73	60.42	61.57	56.22	57.24	56.73	59.47	58.83	59.15
Mean		64.24	62.49	63.37	57.66	59.33	58.50	60.95	60.91	60.93
Brown	15	69.45	67.03	68.24	63.60	59.06	61.33	66.52	63.04	64.78
	30	67.22	65.47	66.35	63.32	57.55	60.43	65.27	61.51	63.39
	45	65.22	62.01	63.62	60.77	55.32	58.05	63.00	58.66	60.83
Mean		67.30	64.84	66.07	62.56	57.31	59.93	64.93	61.07	63.00
Dotted	15	69.40	68.84	69.17	64.47	58.21	61.34	66.94	63.53	65.23
	30	68.14	65.06	66.60	59.32	56.82	58.07	63.73	60.94	62.33
	45	64.07	60.11	62.09	53.17	54.67	53.92	58.62	57.39	58.00
Mean		67.20	64.67	65.94	58.99	55.74	57.78	63.09	60.62	61.86
15		68.19	66.79	67.49	62.26	59.51	60.89	65.23	63.15	64.19
30		66.55	64.36	65.45	60.23	57.95	59.09	63.39	61.15	62.27
45		64.00	60.85	62.43	56.72	55.74	56.23	60.36	58.29	59.33
Mean		66.25	64.00	65.12	59.74	57.73	58.74	62.99	60.86	61.93
L.S.D at: 5% for:		T=1.00 D=0.27 TD=0.47	T=1.32 D=0.28 TD=0.49	T=1.11 D=0.25 TD=0.43	T=3.83 D=0.96 TD=1.66	T=1.28 D=0.95	T=1.61 D=0.92 TD=1.61	T=1.17 D=0.47 TD=0.82 DY=0.67 TDY=1.16	D=0.47 TD=0.81 TY=0.77 DY=0.66 TDY=1.15	T=0.58 D=0.46 TD=0.79 TY=0.82
Stems:										
Creamy	15	56.35	54.19	55.26	49.80	46.76	48.28	53.08	50.46	51.77
	30	53.91	51.04	52.47	48.80	45.54	47.17	51.35	48.29	49.82
	45	52.22	48.87	50.54	44.43	40.65	42.54	48.33	44.76	46.54
Mean		54.16	51.36	52.76	47.68	44.32	45.99	50.92	47.84	49.38
Brown	15	54.78	53.93	54.36	47.31	44.77	46.04	51.04	49.35	50.20
	30	50.61	48.47	49.54	44.38	42.24	43.31	47.50	45.35	46.43
	45	48.47	46.31	47.39	43.34	40.09	41.71	45.91	43.20	44.55
Mean		51.65	49.57	50.43	45.01	42.37	43.69	48.15	45.97	47.06
Dotted	15	51.32	48.81	50.07	49.65	47.20	48.42	50.49	48.00	49.24
	30	50.44	47.20	48.82	48.41	46.27	47.34	49.42	46.73	48.08
	45	47.95	46.12	47.03	43.47	45.60	44.53	45.71	45.86	45.78
Mean		49.91	47.37	48.64	47.18	46.35	46.76	48.54	46.86	47.70
15		54.15	52.30	53.23	48.92	46.24	47.58	51.54	49.27	50.41
30		51.65	48.90	50.28	47.20	44.68	45.94	49.42	46.79	48.11
45		49.55	47.10	48.32	43.75	42.11	42.93	46.65	44.61	45.63
Mean		51.78	49.43	50.61	46.62	44.34	45.48	49.20	46.89	48.05
L.S.D at: 5% for:		T=1.24 D=0.39 TD=0.68	T=0.30 D=0.55 TD=0.96	T=0.59 D=0.41 TD=0.70	D=1.12	T=2.48 D=0.57 TD=0.99	T=1.97 D=0.46 TD=0.79	T=0.78 D=0.56 TD=0.97 TY=1.11 DY=0.53 TDY=1.38	T=0.72 D=0.38 TD=0.65 TY=1.04 DY=0.41 TDY=0.71	T=0.60 D=0.29 TD=0.50 TY=0.86 DY=0.41 TDY=0.71

produced the highest stem-TDN content of the first cut planted at the lowest seeding rates, and Brown type produced the lowest TDN content planted at the highest seeding rates for the second cut.

Digestible Protein (DP) Content

The response of digestible protein content of for each of Bonavista bean and fodder cowpea types as inorganic native herbaceous legumes) planted at various population densities are presented in Tables (23&24). Results showed parallel behaviors trend almost similar to CP content previously presented and discussed.

Table (23): The digestible protein (DP) content for leaves and stems of Bonavista bean types at various seeding rates.

Types (T)	Density (D) Kg/fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Leaves:		……(% on dry matter basis)……								
White	10	18.16	16.87	17.51	18.31	14.06	16.17	18.23	15.46	16.85
	20	16.77	15.67	16.22	14.53	14.06	14.29	15.65	14.86	15.26
	30	12.61	11.98	12.29	13.55	11.87	12.71	13.08	11.92	12.50
Mean		15.85	14.84	15.34	15.46	13.33	14.40	15.66	14.08	14.87
Black	10	25.07	18.16	21.62	17.32	13.28	15.30	21.20	15.72	18.46
	20	20.00	15.38	17.69	15.44	12.42	13.93	17.72	13.90	15.81
	30	17.70	10.31	14.00	14.53	7.48	11.00	16.11	8.89	12.50
Mean		20.92	14.61	17.77	15.76	11.06	13.41	18.34	12.84	15.59
Brown	10	19.07	18.16	18.62	19.21	14.92	17.06	19.14	16.54	17.84
	20	20.92	12.61	16.77	17.96	14.61	16.28	19.44	13.61	16.52
	30	20.92	10.77	15.84	17.96	11.33	14.64	19.44	11.05	15.24
Mean		20.31	13.84	17.07	18.37	13.62	15.99	19.34	13.73	16.53
10		20.77	17.73	19.25	18.28	14.08	16.18	19.52	15.91	17.72
20		19.23	14.55	16.89	15.97	13.69	14.83	17.61	14.12	15.86
30		17.07	11.02	14.05	15.35	10.23	12.78	16.21	10.62	13.41
Mean		19.02	14.43	16.73	16.53	12.67	14.60	17.78	13.55	15.66
L.S.D at: 5% for:		T=1.67 D=0.66 TD=1.14	D=0.66 TD=1.14	T=1.67 D=0.66 TD=1.14	T=2.50 D=0.99	T=2.18 D=0.85 TD=1.48	D=0.92	T=0.89 D=1.26 TD=0.97 TY=1.26 DY=0.79 TDY=1.37	D=0.51 TD=0.89 TY=1.14 DY=0.72 TDY=1.25	T=0.85 D=0.54 TD=0.93 TY=1.20 DY=0.76 TDY=1.31
Stems:										
White	10	8.45	6.15	7.30	6.97	4.80	5.88	7.71	5.47	6.59
	20	7.07	4.76	5.92	6.18	4.48	5.33	6.63	4.62	5.63
	30	5.69	3.38	4.54	5.39	3.71	4.55	5.54	3.54	4.54
Mean		7.07	4.76	5.91	6.18	4.33	5.26	6.63	4.55	5.59
Black	10	3.38	3.84	3.61	5.36	4.52	4.94	4.37	4.18	4.27
	20	3.84	3.38	3.61	4.73	3.99	4.36	4.28	3.69	3.98
	30	3.84	1.53	2.68	5.57	3.99	4.78	4.70	2.76	3.73
Mean		3.69	2.92	3.30	5.22	4.17	4.70	4.45	3.54	4.00
Brown	10	6.10	5.08	5.59	5.27	4.20	4.74	5.69	4.64	5.16
	20	5.30	4.43	4.86	4.37	4.56	4.46	4.83	4.50	4.66
	30	4.22	3.38	3.80	4.37	4.33	4.35	4.30	3.86	4.08
Mean		5.21	4.30	4.75	4.67	4.37	4.52	4.94	4.33	4.63
10		5.98	5.02	5.50	5.87	4.51	5.19	5.92	4.76	5.34
20		5.40	4.19	4.80	5.09	4.51	4.77	5.25	4.27	4.76
30		4.58	2.76	3.67	5.11	4.35	4.56	4.85	3.39	4.12
Mean		5.32	3.99	4.66	5.36	4.01	4.84	5.34	4.14	4.74
L.S.D at: 5% for:		T=2.28 D=0.68 TD=1.18	D=0.67	T=0.12 D=0.67	N.S	N.S	D=0.48	T=0.96 D=0.48 TD=0.83	D=0.41 DY=0.58	T=0.75 D=0.39 TD=0.55 DY=0.55

Table (24): The digestible protein (DP) content for leaves and stems of Fodder cowpea types at various seeding rates.

Types (T)	Density (D) Kg/fed	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Leaves:		.... (% on dry matter basis)								
Creamy	15	19.08	16.77	17.93	16.43	14.92	15.67	17.75	15.85	16.80
	30	17.70	15.35	16.54	16.07	14.37	15.22	16.88	14.88	15.88
	45	15.40	13.08	14.24	16.57	13.52	15.04	15.98	13.30	14.64
Mean		17.39	15.08	16.23	16.36	14.27	15.31	16.87	14.67	15.77
Brown	15	20.82	17.70	19.26	17.96	17.35	17.65	19.39	17.52	18.46
	30	18.22	14.92	16.57	17.68	15.71	16.70	17.95	15.32	16.63
	45	16.24	10.77	13.50	17.05	14.61	15.83	16.64	12.69	14.66
Mean		18.43	14.46	16.44	17.00	15.89	16.72	17.99	15.18	16.58
Dotted	15	23.70	24.17	23.93	17.68	16.02	16.85	20.69	20.09	20.39
	30	23.23	16.78	20.00	16.07	15.71	15.89	19.65	16.25	17.95
	45	15.08	11.23	13.15	16.21	13.83	15.02	15.64	12.53	14.09
Mean		20.67	17.39	19.03	16.82	15.19	15.92	18.66	16.29	17.48
15		21.20	19.55	20.37	17.36	16.10	16.73	19.28	17.82	18.55
30		19.72	15.70	17.71	16.61	15.26	15.93	18.16	15.48	16.82
45		15.57	11.69	13.63	16.61	13.99	15.30	16.09	12.84	14.46
Mean		18.83	15.65	17.24	16.86	15.12	15.99	17.84	15.38	16.61
L.S.D at: 5% for:		T=1.73 D=0.66 TD=1.15	T=1.67 D=0.66 TD=	T=1.70 D=0.66 TD=1.14	N.S	D=0.86	D=1.76	T=0.84 D=0.63 TD=1.09 TY=1.20 DY=0.89 TDY=1.54	T=0.81 D=0.51 TD=0.88 TY=1.14 DY=0.72 TDY=1.25	T=0.83 D=0.57 TD=0.99 TY=1.17 DY=0.81 TDY=1.39
Stems:										
Creamy	15	8.92	5.44	7.17	5.99	6.15	6.07	7.45	5.80	6.62
	30	5.23	3.38	4.30	6.23	5.29	5.76	5.73	4.33	5.03
	45	6.61	2.92	4.76	5.27	3.41	4.34	5.94	3.16	4.55
Mean		6.92	3.91	5.42	5.83	4.95	5.39	6.38	4.43	5.40
Brown	15	6.61	4.30	5.46	6.17	6.71	6.44	6.39	5.50	5.95
	30	5.69	3.84	4.76	5.63	4.75	5.19	5.67	4.30	4.98
	45	3.84	2.92	3.38	5.27	4.20	4.74	4.56	3.56	4.06
Mean		5.38	3.68	4.53	5.69	5.22	5.46	5.54	4.45	4.99
Dotted	15	6.15	4.76	5.46	7.07	5.84	6.46	6.61	5.30	5.96
	30	5.22	3.84	4.53	6.17	5.29	5.73	5.69	4.57	5.13
	45	2.92	3.38	3.15	5.63	3.96	4.80	4.28	3.67	3.97
Mean		4.76	3.99	4.38	6.29	5.03	5.66	5.53	4.51	5.02
15		7.23	3.90	6.03	6.41	6.23	6.32	6.82	5.53	6.18
30		5.38	3.69	4.53	6.01	5.11	5.56	5.70	4.40	5.05
45		4.46	3.07	3.76	5.39	3.86	4.63	4.92	3.46	4.20
Mean		5.69	3.55	5.78	5.94	5.07	5.50	5.81	4.46	5.14
L.S.D at: 5% for:		D=0.41 TD=0.72	D=0.50	D=0.40 TD=0.68	N.S	D=0.86	D=0.83	D=0.47 DY=0.66 TDY=1.15	D=0.47	D=0.44 TDY=1.08

Table (I): Summary of growth behavior and chemical constituents of Bonavista bean and Fodder cowpea types (as an indigenous-native legumes).

No.	Characters	Types	Seeding rates
1	**Bonavista bean :** Fresh forage yield (ton / fed)	16.9% White >Black >Brown	28.5% 30 >20 >10
2	Dry forage yield (ton / fed)	27.9% White >Black >Brown	23.5% 30 >20 >10
3	Plant height (cm)	81.4% Black >White > Brown	36.5% 10 >20 > 30
4	Stem diameter (cm)	12.3% Brown >Black > White	62.7% 10 >20 > 30
5	Leaf area/plant (cm^2)	N.S Brown > White > Black	109% 10 >20 > 30
6	Leaf : Stem ratio	25% Brown > White> Black	N.S 10 >20 > 30
7	Light intensity (Lux)	2.5% White > Black >Brown	6.7% 30 >20 > 10
8	# of shoots/m^2	N.S White > Brown > Black	135.2% 30 >20 > 10
9	**Crude protein (CP %)** Leaf	9% Brown >Black > White	10>20 >30
	Stem	21% White > Brown > Black	10 >20 >30
10	**Crude fiber (CF %)** Leaf	4.3% Brown > White > Black	30 >20 > 10
	Stem	4% Brown > White > Black	30 >20 > 10
11	**Ash (%)** Leaf	Black >White > Brown	30>10 > 20
	Stem	16% Brown > White > Black	N.S 20 >10 > 30
12	**Ether extract (EE %)** Leaf	White > Brown > Black	30 >20 > 10
	Stem	N.S Black >White > Brown	N.S 20 > 10 >30
13	**Nitrogen free extract (NFE %)** Leaf	White > Brown > Black	N.S 10 >30 >20
	Stem	Black > Brown > White	N.S 10>20 >30

No.	Characters	Types	Seeding rates
14	**Total digestible nutrients (TDN)**		
	Leaf	Brown > White > Black	10 >20 > 30
	Stem	Black >White > Brown	10 >20 > 30
15	**Digestible protein (DP %)**		
	Leaf	11% Brown >Black > White	N.S 10 > 30> 20
	Stem	40% White > Brown > Black	10 >20 > 30
16	**Fodder cowpea :**		
	Fresh forage yield (ton / fed)	9.4% Creamy >Dotted >Brown	17.1% 45 >30 >15
17	**Dry forage yield (ton / fed)**	N.S Dotted > Creamy >Brown	18.7% 45 >30 >15
18	**Plant height (cm)**	N.S Creamy >Brown >Dotted	11.5% 15 >30 >45
19	**Stem diameter (cm)**	N.S Creamy >Brown >Dotted	28.8 % 15 >30 >45
20	**Leaf area/plant (cm^2)**	12.8% Creamy >Brown >Dotted	104% 15 >30 >45
21	**Leaf : Stem ratio**	13.8% Brown > Creamy >Dotted	N.S 45>15 >30
22	**Light intensity (Lux)**	2.5% Brown > Creamy >Dotted	8.9% 45 >30 > 15
23	**# of shoots/m^2**	9.4% Creamy >Dotted >Brown	12.2% 45 >30 > 15
24	**Crude protein (CP %)**		
	Leaf	8.8% Dotted > Brown > Creamy	15>30 > 45
	Stem	N.S Creamy >Brown >Dotted	15>30 >45
25	**Crude fiber (CF %)**		
	Leaf	Creamy >Dotted >Brown	45 >30 >15
	Stem	7.6% Brown > Dotted > Creamy	45 >30 >15
26	**Ash (%)**		
	Leaf	N.S Dotted > Creamy >Brown	15 >30 > 45
	Stem	5% Brown > Dotted > Creamy	N.S 15 >30 > 45

No.	Characters	Types	Seeding rates
27	**Ether extract (EE %)**		
	Leaf	2.5% Creamy >Dotted >Brown	N.S 45 >30 >15
	Stem	Dotted > Brown > Creamy	15>30 > 45
28	**Nitrogen free extract (NFE %)**		
	Leaf	Brown > Creamy >Dotted	30 >15> 45
	Stem	Creamy >Dotted >Brown	15 >30 > 45
29	**Total digestible nutrients (TDN)**		
	Leaf	Brown > Dotted > Creamy	15 >30 >45
	Stem	Creamy >Dotted >Brown	15 >30 > 45
30	**Digestible protein (DP %)**		
	Leaf	Dotted > Brown > Creamy	15 >30 >45
	Stem	N.S Creamy >Dotted >Brown	15 >30> 45

II-Anticipated beneficial potentiality of the studied promising indigenous-native legumes

From the evaluation of the 6 indigenous native legumes, it is worth trying to investigate their extra performance when mixing with pearl millet in a complementary informative study.

For this particular target, the well known beneficial effect of mixing leguminous forage crops with grasses as pearl millet (Shandawil1). It proved to be superior in production and quality in previous M.Sc. study **(Saad, A.M., 2006)** under the same circumstances of running and conducting this investigation. Where the mixing ratio was 50% fodder legumes and 50% of pearl millet. Results of these trials will be presented and discussed as follows:

Fresh forage yield

In comparing the total fresh forage yield of pure stands of Bonavista bean types, it clear from the combined analysis that white B.type was of significant superior production (20.45 ton/fed.) as compared with the other types under study, (Table 25).Whereas, the Brown and Black types produced almost similar fresh forage yield which was 17.85 and 17.45 ton/fed, respectively with significant increase of about 17 % than the other two types. In other words, the White type of Bonavista bean proved to be the best in fresh forage production compared with Brown and Black types where there was no appreciable difference in production between the later two types.

Seasonal variations exerted significant difference in fresh forage yield among the tested Bonavista bean types (Table 25). Results indicate that white type of Bonavista bean was significantly the highest in total fresh forage yield. These results were true in each of the two growing seasons.

The combined analysis proved that the total fresh forage yield was relatively higher in the second cuts than the first ones for all of the tested B. bean types with different significant magnitudes (Table 25). Data also evaluated the increase in productivity of total fresh yield of white B. bean type which was 29 % in the first cuts and 7.7 % in

the second cuts. Whereas, there was no significant variation between Brown and Black types (Table 25).

It is also noticed that all of the three tested B.bean types produced relatively slightly higher total forage yield in the first season than the second one. This result could be due to the warmer environmental circumstances of the second season as compared with the previous season (Table 2-b).

Unlikely with Bonavista bean, the total forage yield from the combined analysis did not show significant differences within the three tested indigenous native F. Cowpea types in their pure stands(Table 25). Whereas, different trend was noticed for cowpea types in their total fresh forage yield during the seasonal variations where the slight higher production was noticed during the second season rather than the first one. This case was quite different than for B.bean types previously presented. Such obtained results indicate that cowpeas are of more stimulated growth during warmer summer of the second season than B.bean types as presented previously (Table 2-b).

Data in Table (25) of the combined analysis proved that all of the pure stands of the three types of Fodder cowpea showed significant higher reduction in total fresh forage yield during the second cuts as compared with the first cuts with almost similar magnitudes. This result could be due to the noticed higher rust and other pathogenic infection and the lower shooting rate as well which caused the reduction of growth behaviour during the second cuts.

Regarding the comparison between all of the tested six types of indigenous native legumes in their pure stands, the combined analysis revealed that each of the 3 types of B.bean was higher in total fresh forage yield as compared with any of the tested Fodder cowpea types (Table 25). This result confirms the more productivity of B.bean types than F.cowpea types in general.

Moreover, White type of B.bean was more productive type than the other two B.bean types. (Brown and Black type) with significant differences. However, Fodder cowpea types were of no appreciable differences in their total fresh forage yield. However, the respective production could be presented in the following descending order in Brown

cowpea, Creamy cowpea then Dotted cowpea type. Seasonal variations indicated that more total fresh forage yield was obtained in the second season than the first one, with slight ignorable differences.

From the combined analysis data for all of the studied indigenous-native legumes, it could be concluded that total fresh forage yield was higher in the second season than the first one with significant differences. Also, the descending ranking order in pure stand production was as follow: White B.bean (20.45), Brown cowpea (18.95), Creamy cowpea (18.80), Dotted cowpea (18.45), Brown B.bean (17.85) and Black B.bean (17.45 ton / fed).

Whereas, Black Bonavista bean was the least in production for the first cut, but the White Bonavista bean was 105 % higher in total forage production as compared to with the Dotted Fodder cowpea during the second cut. Moreover, Dotted Fodder cowpea was higher in total fresh yield with about 72.3 % than Black Bonavista bean during the first cut.

Combined analysis proved that mixing Pearl millet (PM) with any of the six Fodder legumes (at 50:50 % ratio) could be ranked in descending order in respect to fresh forage yield as follow: PM+ BrB $_{(28.60)}$ > PM+ WB $_{(28.25)}$ > PM+BB $_{(27.25)}$ > PM+BrFC $_{(26.40)}$ > PM+DFC$_{(25.35)}$ > PM+CFC$_{(23.60\ ton/fed.)}$, with the same significant differences among the subsequent order.

It is more likely recommended that either of the two mixtures Pearl millet (PM) + Brown Bonavista bean (BrB) and Pearl millet (PM) + White Bonavista bean (WB) were the best combinations in total fresh forage biomass.

Results of the combined analysis indicated (Table 25) that fresh forage production of the proposed mixture was of much more magnitudes during the second compared with the first season with significant differences. So, it looks to be true that mixtures were quite successful in growth and production during the warmer summer of the second season as it is clear in Table (2-b).

Similar significant differences in total fresh yield within the proceeded cuts with different behaviour among the grown forage mixtures were recorded by **Abd El Gawad *et al.* (1990)** for the intercropped sordan with cowpea, **Abo Deya *et al.* (1990)** for the intercropped sordan with cowpea, **Mohanpillai *et al.* (1990)** for the intercropped maize with cowpea, **Singh and Ahuja (1990)** for the intercropped sorghum with cowpea, **Abd El Aal *et al.* (1991)** for the intercropped sordan with guar, **Abd El Gawad *et al.* (1992)** for the intercropped Sudan grass with cowpea, **Nor El Din *et al.* (1992)** for the intercropped Pearl millet with guar, **Sood and Sharma (1992)** for the intercropped sorghum with cowpea, **Dubey *et al.* (1995)** for the intercropped sorghum with soybean and **Geren *et al.* (2008)** for the intercropped maize with cowpea.

It is well noticed that mixtures of Fodder cowpea types were of higher fresh forage yield during the first cut compared with the second cut. Similar trend was obtained for its pure stand as it is clear in the previously mentioned comparisons (page 24).Whereas, Bonavista bean types behaved in an opposed trend as Fodder cowpea types previously presented and discussed, where the earlier cuts of B.bean types was higher than the later cuts

For clear cut comparison: the total fresh forage yield for mixtures with their relevant pure stand components assuming cropping in similar land unit area:

Mixtures product (ton /fed)	**Actual production in pure stands** (ton /fed)	**% of increase for each component of the related mixtures**
Actual production of mixtures (50:50%)	Pearl millet + legumes	PM + legumes
PM + BrB (28.60)	27.90 + 17.85	2.5 + 60 %
PM − WB (28.25)	27.90 + 20.45	1.3 + 38 %
PM + BB (27.25)	27.90 + 17.45	2.4 + 56 %
PM − BrFC (26.40)	27.90 + 18.95	5.7 + 39 %
PM + DFC (25.35)	27.90 + 18.45	10 + 37 %
PM + CFC (23.60)	27.90 + 18.80	18 + 25 %

The descending ranking order of the fresh yield for the grown forage mixtures and their relevant pure stands in the following comparative set of data:

NO.	Treatments		Total fresh forage yield (ton/fed)
1	Pearl millet + Brown Bonavista bean	(PM + BrB)	28.60
2	Pearl millet + White Bonavista bean	(PM+WB)	28.25
3	Pearl millet	(PM)	27.90
4	Pearl millet + Black Bonavista bean	(PM + BB)	27.25
5	Pearl millet + Brown Fodder cow pea	(PM + BRFC)	26.40
6	Pearl millet + Dotted Fodder cow pea	(PM + DFC)	25.35
7	Pearl millet + Creamy Fodder cow pea	(PM + CFC)	23.60
8	White Bonavista bean	(WB)	20.45
9	Brown Fodder cow pea	(BRFC)	18.95
10	Creamy Fodder cow pea	(CFC)	18.80
11	Dotted Fodder cow pea	(DFC)	18.45
12	Brown Bonavista bean	(BRB)	17.85
13	Black Bonavista bean	(BB)	17.85
	L.S.D at: 5 % for :		T= 1.88

Dry forage yield

Results in Table (26) represent total dry forage yield of pure B.bean types as it is clear from the combined analysis as well. The combined analysis indicates significant differences among the studied Bonavista bean types. The White type was of the highest significant dry forage production (3.01 ton/fed), whereas, Black and Brown Bonavista bean produced almost similar dry forage yield which was 2.70 and 2.55 ton /fed, respectively. So, the White type was of about 18% higher in dry forage yield as compared with the other two types (Black and Brown) in their pure stand where was no appreciable difference in production between the late two types.

Table (25): Fresh yield productivity of the studied forage legumes and pearl millet in their pure stands and relevant mixtures.

Pure & Mixtures Forages*		First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Total	1st cut	2nd cut	Total	1st cut	2nd cut	Total
		........................(ton / fed.)........................								
Pure stands	PM	13.0	*14.10*	27.10	13.90	14.80	28.70	13.45	*14.45*	27.90
	W B	10.0	10.40	20.40	10.0	10.50	20.50	10.0	10.45	20.45
	B B	7.70	11.10	18.80	7.80	8.30	16.10	7.75	9.70	17.45
	BR B	6.70	11.10	17.80	8.90	9.0	17.90	7.80	10.05	17.85
	CFC	12.40	6.30	18.70	12.70	6.20	18.90	12.55	6.25	18.80
	BRFC	12.70	5.0	17.70	13.90	6.30	20.20	13.30	5.65	18.95
	D FC	13.10	4.60	17.70	13.60	5.60	19.20	13.35	5.10	18.45
Relevant mixtures (50 + 50 %)	PM + W B	11.0	13.30	24.30	16.10	16.30	32.40	13.55	14.70	28.25
	PM + B B	9.60	12.0	21.60	16.40	16.50	32.90	13.0	14.25	27.25
	PM + BR B	11.70	14.20	25.90	15.50	15.80	31.30	13.60	15.0	28.60
	PM + CFC	9.90	10.70	20.60	14.20	12.40	26.60	12.05	11.55	23.60
	PM+BRFC	13.30	12.40	25.70	15.20	11.90	27.10	14.25	12.15	26.40
	PM + D FC	12.90	12.30	25.20	14.30	11.20	25.50	13.60	11.75	25.35
LSD at: 5% for:		F= 2.23	F= 2.05	F= 3.24	F= 1.55	F= 1.48	F= 2.02	F= 1.33 , FY=1.88	F= 1.24 , FY= 1.75	F= 1.88 , FY= 2.65

*PM = Pearl millet, WB = White Bonavista bean, BB = Black Bonavista bean, BRB = Brown Bonavista bean, CFC = Creamy Fodder cow pea, BRFC = Brown Fodder cow pea, DFC = Dotted Fodder cow pea.

Seasonal variations exerted significant difference in dry forage yield among the tested pure stands of Bonavista bean types (Table 26). Results indicate that White type of Bonavista bean was significantly the highest in total dry forage yield compared to each of other two types (Black and Brown). This result was true in the two growing seasons.

Also, the combined analysis proved that total dry forage yield was generally higher in the second cuts than the first ones for all of the tested B. bean types with slight different significant magnitudes. The superiority in dry yield production of White B. bean type compared with the other two types was 35 % in the first cuts and 8 % in the

second cuts. Whereas, there was no significant differences in dry yield between the Black and Brown types (Table 26).

It is also noticed that all of the three tested B.bean types produced relatively slightly higher total dry forage yield in the second season than the first one. This result could be due to the warmer circumstances of the second season as compared with the previous season (Table 2-b).

Regarding fodder cowpea types in its pure stands, the total dry yield from the combined analysis showed significant differences within the three tested indigenous native F.cowpea types (Table 26).

Whereas, different trend was noticed for cowpea types in their total dry forage yield among the seasonal variations, where the higher dry yield was noticed during the second season rather than the first one. This case was quite different than for B.bean types previously presented. Such obtained resulted indicate that cowpeas are of more stimulated growth during warmer summer (Table 2-b) than B.bean types as presented previously.

Data in Table (26) of the combined analysis proved that all of the three types of fodder cowpea showed significant higher reduction in total dry forage yield during the second cuts as compared with the first ones with almost similar magnitudes. This result could be due to the noticed higher rust infection and, lower shooting rates and the reduction of growth behaviour as well. However, Bonavista bean types behaved in an opposed trend as for Fodder cowpea types previously presented and discussed.

Regarding the overall comparisons between all of the tested six types of indigenous native legumes, the combined analysis clarified that each of the White and Black types of Bonavista bean was higher in total dry yield as compared with any of the tested fodder cowpea types (Table 26). These results confirm the more productivity of B.bean types than F.cowpea types.

Moreover, White type of B.bean was more productive type than the other two types. (Black and Brown type) with significant differences. However, Fodder cowpea types

were of no appreciable differences in their total dry forage yield. The respective production could be presented in the following descending order in Brown cowpea then Creamy followed by Dotted type. Seasonal variations indicated more total dry yield in the first season than the second one, with slight ignorable differences.

It is generally noticed that, total dry forage yield was higher in the first season than the second one with significant differences. The descending ranking order of dry yield in pure stands was as follow: White Bonavista bean, Black B.bean, Brown cowpea, Creamy cowpea, Dotted cowpea then Brown B.bean. From such ranking order Brown Fodder cowpeas type was the most productive during the first cut and Dotted Fodder cowpeas of the lowest production during the second cut. Whereas, Brown Bonavista beans was of the least in production for the first cut, but the White Bonavista bean was 115 % higher in total dry yield as compared with the Dotted Fodder cowpea during the second cut. Moreover, Brown Fodder cowpea was higher in total dry yield with about 74.5 % than Brown Bonavista bean during the first cut.

Combined analysis proved that mixtures of 50 % pearl millet – 50 % of dry forage production for any of the six Fodder legumes could be ranked in the following descending order regarding dry matter production: PM–WB $_{(4.48)}$ > PM–BrB $_{(4.35)}$ > PM–BB $_{(4.0)}$ > PM+BrFC $_{(3.94)}$ > PM+DFC $_{(3.73)}$ > PM+CFC $_{(3.40\ \text{ton/fed.})}$, with some significant differences in between as shown in Table (26).

It is more likely recommended that mixtures of Pearl millet (PM) – White Bonavista bean (WB) and Pearl millet (PM) + Brown Bonavista bean (BrB) were of the best combinations regarding dry forage yield.

From the combined analysis (Table 26), it is also clear that dry forage yield of the proposed mixture was much more in production during the second season compared with the first one with significant differences. This result may confirm the benefit of the dry forage yield production during hot days of the late summer seasons for the second rather than the first cuts.

cowpea, **Zeidan *et al.* (2003)** Fodder maize with cowpea and **Ibrahim *et al.*(2006)** maize with cowpea.

Bonavista bean types were also higher in dry fodder yield when mixed with millet at any of grown tested types of fodder cowpeas for the latest than the earliest cuts.

Also, it is noticed that there was a significant difference in total dry yield for the later than the previous cuts with different behaviour among the grown mixtures. The currently presented results of the behaviour of dry forage productivity of fodder crops and their mixtures were more or less similar those reported by Mohanpillai et al. (1990) maize with cowpea, Abd El Aal *et al.* (1991) sordan with guar, Abd El Gawad

For clear cut comparison the total dry forage yield for mixtures with their relevant pure stand components assuming cropping in similar land unit area:

Mixtures product (ton /fed)	**Actual production in pure stands** (ton /fed)	**% of increase for each component of the related mixtures**
Actual production of mixtures (50:50%)	Pearl millet + legumes	PM + legumes
PM + WB (4.48)	4.74 + 3.01	6 + 49 %
PM + BrB (4.35)	4.74 + 2.55	9 + 70 %
PM + BB (4.00)	4.74 + 2.70	18 + 48
PM + BrFC (3.94)	4.74 + 2.69	20 + 46 %
PM + DFC (3.73)	4.74 + 2.56	27 + 46 %
PM + CFC (3.73)	4.74 + 2.63	39 + 29 %

***et al.* (1992)** Sudan grass with cowpea, **Nor El Din *et al.* (1992)** Pearl millet with guar, **Sood and Sharma (1992)** sorghum with cowpea, **Haggag (1998)** sorghum with

So, it could be concluded that for any of the tested indigenous native forage legumes, their first cuts were of more fresh and dry yield than the second cuts. This may clarify the similarity of vegetative growth for such types of legumes as affected by the prevailing environmental conditions which could be quite different during the earlier than the latest stage of the stand growth.

The descending ranking order of the dry yield for the grown forage mixtures and their relevant pure stands in the following comparative set of data:

NO.	Treatments		Total dry forage yield (ton/fed)
1	Pearl millet	(PM)	4.74
2	Pearl millet + White Bonavista bean	(PM + WB)	4.48
3	Pearl millet + Brown Bonavista bean	(PM +BRB)	4.35
4	Pearl millet + Black Bonavista bean	(PM + BB)	4.0
5	Pearl millet + Brown Fodder cow pea	(PM+ BRFC)	3.94
6	Pearl millet + Dotted Fodder cow pea	(PM + DFC)	3.73
7	Pearl millet + Creamy Fodder cow pea	(PM + CFC)	3.40
8	White Bonavista bean	(WB)	3.01
9	Black Bonavista bean	(BB)	2.70
10	Brown Fodder cow pea	(BRFC)	2.69
11	Creamy Fodder cow pea	(CFC)	2.63
12	Dotted Fodder cow pea	(DFC)	2.56
13	Brown Bonavista bean	(BRB)	2.55
	L.S.D at: 5 % for :		T=0.35

Number of shoots / m^2

Number of shoots/m^{2}of pure B.bean types as it is clear from the combined analysis are presented in Table (27).Results of the combined analysis indicate appreciable significant differences among the studied Bonavista bean types. The White type was of the highest significant number of shoots/m^2 (22.25 shoots/m^2), whereas, Brown and Black Bonavista bean produced almost similar numbers of shoots/m^2 which was 16.75 and 13.25 shoots/m^2, respectively. So, the White type was of about 68% higher in number of shoots/m^2 as compared with the other two types (Brown and Black) with no appreciable difference in number of shoots/m^2 between the later two types.

Seasonal variations showed significant difference in number of shoots/m^2 among the tested Bonavista bean types. Results indicated that White type of Bonavista bean was of significantly highest number of shoots/m^2 compared to each of other two types (Brown and Black). This result was true in the two growing seasons. It is also noticed

Table (26): Dry yield productivity of the studied forage legumes and pearl millet in their pure stands and relevant mixtures.

Pure & Mixtures Forages*		First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Total	1st cut	2nd cut	Total	1st cut	2nd cut	Total
		......................(ton / fed.)......................								
Pure stands	PM	1.93	2.93	4.86	2.0	2.64	4.64	1.96	2.78	4.74
	WB	1.62	1.67	3.29	1.34	1.38	2.72	1.48	1.53	3.01
	BB	1.39	1.83	3.22	1.08	1.11	2.19	1.23	1.47	2.70
	BRB	0.93	1.70	2.63	1.28	1.21	2.49	1.10	1.45	2.55
	CFC	1.70	0.96	2.66	1.73	0.86	2.59	1.72	0.91	2.63
	BRFC	1.90	0.70	2.60	1.94	0.84	2.78	1.92	0.77	2.69
	DFC	1.76	0.70	2.46	1.94	0.72	2.66	1.85	0.71	2.56
Relevant mixtures (50 + 50 %)	PM + WB	1.73	2.41	4.14	2.36	2.43	4.79	2.04	2.42	4.48
	PM + BB	1.39	1.99	3.38	2.22	2.40	4.62	1.80	2.20	4.0
	PM + BRB	1.67	2.52	4.19	1.91	2.61	4.52	1.79	2.56	4.35
	PM + CFC	1.38	1.95	3.33	1.80	1.67	3.47	1.59	1.81	3.40
	PM + BRFC	1.84	2.02	3.86	2.05	1.96	4.01	1.95	1.99	3.94
	PM + DFC	1.77	2.05	3.82	1.88	1.76	3.64	1.82	1.91	3.73
LSD at: 5% for:		F= 0.34	F= 0.38	F= 0.53	F= 0.32	F= 0.37	F= 0.49	F= 0.23 , FY= 0.33	F= 0.26 , FY= 0.37	F= 0.35 , FY= 0.50

*PM = Pearl millet, WB = White Bonavista bean, BB = Black Bonavista bean, BRB = Brown Bonavista bean, CFC= Creamy Fodder cow pea. BRFC = Brown Fodder cow pea, DFC = Dotted Fodder cow pea.

that all of the three tested B.bean types produced relatively slightly higher number of shoots/m^2 in the first season than the second one.

Also, the combined analysis proved that number of shoots/m^2 was generally higher in the first cuts than the second ones for all of the tested B. bean types with different significant magnitudes. The superiority in number of shoots/m^2 of White Bonavista bean type compared with the other two types was 96 % in the first cuts and 64 % in the second cuts. Whereas, the Black and Brown types were of almost similar number of shoots/m^2 during the second cuts. But, there was an appreciable significant differences in between during the first cuts (Table 27).

Number of shoots/m^2 (from the combined analysis) exerted significant differences within the three tested indigenous native F.cowpea types. Whereas, similar trend was noticed for cowpeas type in their number of shoots/m^2 among the seasonal variations, where the highest number of shoots/m^2 was noticed during the first season rather than the second one. Similar trend was noticed for B.bean types (Table 27).

Combined analysis proved that in pure stands, all of the three types of Fodder cowpea exerted significant higher reduction in number of shoots/m^2 during the second cuts as compared with the first ones with almost similar magnitudes. This result could be due to the noticed higher rust infection and, lower shooting rates and the reduction of growth behaviour as well. However, Bonavista bean types behaved in an opposed trend as for Fodder cowpea types previously presented and discussed (Table 27).

Regarding the overall comparisons between all of the tested six types of indigenous herbaceous native legumes in their pure stands, the combined analysis showed that the Dotted type of Fodder cowpeas was the highest in number of shoots/m^2 as compared with any of the tested forage legumes types (Table 27). These results confirm the more number of shoots/m^2 of F.cowpea types than B onavista bean types.

Moreover, Brown and Creamy types of F.cowpea were almost similar in number of shoots/m^2 with ignorable differences in between. However, the respective shoots could be presented in the following descending ranking order: White, Brown and Black Bonavista bean types.Seasonal variations indicated more shoots in the first season than the second one, with slight ignorable differences.

It is generally noticed that, number of shoots/m^2 was higher in the first season than the second one with significant differences. The descending ranking order of shoots in pure stands was as follow: Dotted cowpea, Brown cowpea, Creamy cowpea, White Bonavista bean, Brown Bonavista bean then Black Bonavista bean. From such ranking order Dotted Fodder cowpea type was the highest shoots during each of the two cuts and Black B.bean of the lowest number of shoots/m^2 during the first cut. Whereas, Brown Bonavista bean was of the least number of shoots/m^2 for the second cut, but the Dotted Fodder cowpea was of about 537% and 759% higher in number of shoots/m^2 as

compared with the Black and Brown Bonavista bean types during each of the respective two cuts with significant differences. This is more likely due to the unique nature of growth of Bonavista bean and Fodder cowpea.

Combined analysis proved that mixture number of shoots for the six tested Fodder legumes with pearl millet could be ranked in the following descending order: $PM_{(2/3)}+DFC_{(1/3)} > PM_{(3/4)}+CFC_{(1/4)} > PM_{(4/5)}+BrFC_{(1/5)} > PM_{(5/6)}+BrB_{(1/6)} > PM_{(6/7)}+WB_{(1/7)} > PM_{(15/16)}+BB_{(1/16)}$ within each of the subsequent order as shown in Table (27).

It is more likely recommended that either of the two mixtures Pearl millet (PM) + Dotted Fodder cowpea (DFC) and Pearl millet (PM) + Creamy Fodder cowpea (CFC) were of the best selected combinations regarding number of shoots/m^2. Whereas, increasing number of legume shoots in mixtures increased the nutritive value (TDN and DP) which improve forage quality.

From the combined analysis (Table 27), it is also clear that number of shoots of the proposed mixture was much more in the first season compared with the second one. This is in addition to the well know beneficial impact of mixing legumes and grasses especially for the free nitrogen fixation from the ambient air through rhyzobium inculation. This is in addition of enhancing the well known benefits of grasses and legumes mixtures.

Also, it is noticed that there was appreciable difference in number of shoots/m^2 for the first than the later cuts with different behaviour among the grown mixtures. The currently presented results of the behaviour of number of shoots/m^2 of fodder crops and their mixtures were more or less similar to those reported by **Abd El Gawad *et al.* (1990)** for sordan + Fodder cowpea mixtures.

It is well noticed that the mixtures of Fodder cowpea types were of highest number of shoots/m^2 during the first cuts compared with the second ones. This result was similar in case when Fodder cowpea types were grown in its own pure stands.

Bonavista bean types were also higher in number of shoots/m^2 of its mixture with millet at any of the grown tested types of fodder cowpeas for the earliest than the latest cuts.

It looks to be true that, either Bonavista beans or Fodder cowpeas as a herbaceous leguminous crops produced higher number of shoots/m^2 in the first than the second cuts in general.

So, it could be concluded that for any of the tested indigenous native herbaceous forage legumes, their first cuts were of more number of shoots/m^2 than the second cuts. This may clarify the similarity of vegetative growth for such types of herbaceous legumes as affected by the prevailing environmental conditions which could be quite different during the earliest than the latest cuts.

For clear cut comparison number of shoots/m^2 for mixtures with their relevant pure stands components assuming cropping in similar land unit area are presented as follows:

Mixtures product (# of shoots/m^2)	**Actual production in pure stands** (# of shoots/m^2)	**% of increase for each component of the related mixtures**
Actual production of mixtures (50:50%)	Pearl millet + legumes	PM + legumes
PM + DFC (91+40)	151+90	66 + 125 %
PM + CFC (82+25)	151+70	84 + 64 %
PM +BrFC (98+26)	151+77	54 + 196 %
PM + BrB (80+16)	151+17	89 + 6 %
PM + WB (95+14)	151+22	59 + 57 %
PM + BB (106+8)	151+13	42 + 62 %

Table (27): Number of shoots per sq. meter of the studied forage legumes and pearl millet in their pure stands and relevant mixtures.

	Pure & Mixtures Forages*	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
		........................(# of shoots / m²)........................								
Pure stands	PM	151	*169*	160	180	102	141	165.5	*135.5*	150.5
	WB	32	20	26	21	16	18.5	26.5	18.0	22.25
	BB	15	16	15.5	12	10	11	13.5	13.0	13.25
	BRB	27	12	19.5	18	10	14	22.5	11.0	16.75
	CFC	73	69	71	68	70	69	70.5	69.5	70.0
	BRFC	65	82	73.5	92	69	80.5	78.5	75.5	77.0
	DFC	89	103	96	83	86	84.5	86.0	94.5	90.25
Relevant mixtures (50 + 50 %)	PM + W B	0.74+ 0.26	0.90+ 0.10	0.82+ 0.18	0.88+ 0.12	0.94+ 0.06	0.91+ 0.09	0.81+ 0.19	0.92+ 0.08	0.86+ 0.14
	PM + B B	0.92+ 0.08	0.95+ 0.05	0.93+ 0.07	0.93+ 0.07	0.94+ 0.06	0.94+ 0.06	0.93+ 0.07	0.95+ 0.05	0.94+ 0.06
	PM + BR B	0.74+ 0.26	0.78+ 0.22	0.76+ 0.24	0.88+ 0.12	0.90+ 0.10	0.89+ 0.11	0.81+ 0.19	0.84+ 0.16	0.83+ 0.17
	PM + CFC	0.68+ 0.32	0.66+ 0.34	0.67+ 0.33	0.84+ 0.16	0.87+ 0.13	0.86+ 0.14	0.76+ 0.24	0.77+ 0.23	0.77+ 0.23
	PM+ BRFC	0.72+ 0.28	0.81+ 0.19	0.77+ 0.23	0.77+ 0.23	0.84+ 0.16	0.81+ 0.19	0.75+ 0.25	0.83+ 0.17	0.79+ 0.21
	PM + DFC	0.67+ 0.33	0.57+ 0.43	0.62+ 0.38	0.75+ 0.25	0.83+ 0.17	0.79+ 0.21	0.71+ 0.29	0.70+ 0.30	0.70+ 0.30
LSD at: 5% for:		F= 13.58	F= 16.43	F= 11.02	F= 11.97	F= 8.92	F- 6.97	F= 8.90, FY=12.58	F= 9.19, FY- 12.99	F= 6.41, FY- 9.06

* PM = Pearl millet, WB = White Bonavista bean, BB = Black Bonavista bean, BRB = Brown Bonavista bean, CFC= Creamy Fodder cow pea, BRFC = Brown Fodder cow pea, DFC = Dotted Fodder cow pea.

The descending ranking order of the number of shoots/m² for the grown forage mixtures and their relevant pure stands in the following comparative set of data:

NO.	Treatments		number of shoots/ m^2
1	Pearl millet	(PM)	151
2	Pearl millet + Dotted Fodder cow pea	(PM + DFC)	91+40
3	Pearl millet + Brown Fodder cow pea	(PM+BRFC)	98+26
4	Pearl millet + Black Bonavista bean	(PM + BB)	106+8
5	Pearl millet + White Bonavista bean	(PM +WB)	95+14
6	Pearl millet + Creamy Fodder cow pea	(PM + CFC)	82+25
7	Pearl millet + Brown Bonavista bean	(PM + BRB)	80+16
8	Dotted Fodder cow pea	(DFC)	90
9	Brown Fodder cow pea	(BRFC)	77
10	Creamy Fodder cow pea	(CFC)	70
11	White Bonavista bean	(WB)	22
12	Brown Bonavista bean	(BRB)	17
13	Black Bonavista bean	(BB)	13
	L.S.D at: 5 % for :		T= 6.41

Chemical Constituents

Crude protein (CP) content

In comparing crude protein (CP) content of pure B.bean types, the combined analysis indicated that the Brown and white B.bean types produced almost similar CP content which was 21.05 and 20.62 %, respectively without significant differences in between. Whereas, Black B. bean type was of the lowest significant CPcontent (16.43 %), which was of about 28 % lower in CP content as compared with each of the other two Bonavista bean types in their pure stands(Table 28).

Seasonal variations exerted significant difference in CP content among the tested Bonavista bean types in their pure stands. Results indicate that White type of Bonavista bean was significantly the highest in CP content compared to each of other two types (Black and Brown) during the first season. Meanwhile, Brown type of Bonavista bean was significantly the highest in CP content compared to each of other two types (White and Black) during the second season.

It looks to be true that combined analysis proved that CP content was generally higher in the first cuts than the second cuts for all of the tested Bonavista bean types with slight different significant magnitudes. The superiority in CP content of Brown B. bean type compared with the other two types was 23 % in the first cuts and 33 % in the second cuts. Whereas, differences between the Brown and White types were not detected.

It is also noticed that all of the three tested B.bean types produced relatively slight higher CP content in the second season than the first one. This result could be due to relatively higher ambient temperature of the second season as compared with the previous season as shown in Table (2-b).

Combined analysis exerted significant differences within the three tested indigenous native F.cowpea types in CP contents in their pure stands and among seasons as well(Table 28).

This case was quite similar for Bonavista bean types previously presented. Such obtained resulted indicate that each of cowpeas and B.bean types are of more stimulated growth during the hot summer season as presented previously.

Results in Table (28) of the combined analysis proved that all of the three types of Fodder cowpea had significant higher reduction in CP content during the second cuts as compared with the first ones with almost similar magnitudes.

This result could be due to the noticed higher rust infection and, lower shooting rates and the reduction of growth behaviour as well. However, Bonavista bean types behaved in a similar trend as for Fodder cowpea types previously presented and discussed (Table 28).

Along the overall comparisons between all of the tested six types of indigenous native herbaceous legumes, the combined analysis clarified that each of the Brown and White types of Bonavista bean was higher in CP content as compared with any of the tested fodder cowpea types (Table 28). These results confirm the high CP content of B.bean types compared to F.cowpea types.

Moreover, Brown type of B.bean was of more CP content type than the other two B.bean types (White and Black type) with significant differences. However, Fodder cowpea types were of appreciable differences in their CP, the respective CP content could be presented in the following descending order:Creamy, Dotted and Brown cowpea. whereas, there were no appreciable differences between the latter two types of fodder cowpea.

It is generally noticed that CP content was higher in the second season than the first one with significant differences. The descending ranking order of CP content in pure stands was: Brown Bonavista bean, White Bonavista bean, Creamy cowpea, Dotted cowpea, Brown cowpea then Black Bonavista bean. From such ranking order Brown Bonavista bean type was the most highest in CP content during each of the two cuts, and Black type was the lowest of CP content during each of the subsequent two cuts. Whereas, there was about 23 %and 33 % high CP content as compared with the Black B.bean during the first and second cuts, respectively, with slight significant differences (Table 28).

Combined analysis clarified that Fodder cowpea types have more CP content than Bonavista bean types in their relevant mixtures with pearl millet. The CP content for mixtures of pearl millet with any of the six Fodder legumes could be ranked in the following descending order: PM+DFC > PM+BrFC > PM+CFC > PM+BrB > PM+WB > PM+BB type having a respective CP content of 12.09, 11.99, 11.80, 10.66, 9.98 and 9.66 %with some significant differences in between as shown in Table (28).

It is more likely recommended that mixtures Pearl millet (PM) + Dotted Fodder cowpea (DFC) and Pearl millet (PM) + Brown Fodder cowpea (BrFC) were of the best combinations regarding CP content.

It is also clear that from the combined analysis (Table 28) CP content of the proposed mixture was slightly higher during the second season compared with the first one with significant differences. This result may confirm the benefit of the increase in CP content during hot summer days of the second season (Table 2-b). This is in addition

to the well know beneficial impact of mixing legumes and grasses especially for free nitrogen fixation from the ambient air through the rhyzobium bacterium activities.

The currently presented behaviour of CP content of fodder crops and their mixtures were more or less similar those reported by **Zeidan *et al.* (2003)** for mixture of Fodder maize with cowpea, **Chambliss and Ezenwa (2006)** for mixtures of Pearl millet with lablab, **Ibrahim *et al.*(2006)** for mixture maize with cowpea, **Armstrong *et al.* (2008)** for mixtures of maize with lablab and **Geren *et al.* (2008)** for mixtures of maize with cowpea.

It looks to be true that, either of Bonavista beans or Fodder cowpeas as a leguminous crops produced higher CP content in the first than the second cuts in general. This may clarify the similarity of vegetative growth for such types of legumes and grass in their mixtures as affected by the prevailing environmental conditions.

For clear cut comparison, the CP content for mixtures with their relevant pure stand components assuming cropping in similar land unit area:

Mixtures product (%)	**Actual production in pure stands** (%)	**% of increase for each component of the related mixtures**
Actual production of mixtures (50:50%)	Pearl millet + legumes	PM + legumes
PM + DFC (12.09)	**9.73 + 18.89**	**24 + 94 %**
PM + BrFC (11.99)	**9.73 + 18.40**	**23 + 53 %**
PM + CFC (11.80)	**9.73 + 20.31**	**21 + 72 %**
PM + BrB (10.66)	**9.73 + 21.05**	**10 + 97%**
PM +WB (9.98)	**9.73 + 20.62**	**3 + 106 %**
PM + BB (9.65)	**9.73 + 16.43**	**0.8 + 70 %**

The descending ranking order of the crude protein (CP) content for the grown forage mixtures and their relevant pure stands in the following comparative set of data:

NO.	Treatments		Crude protein content (%)
1	Brown Bonavista bean	(BRB)	21.05
2	White Bonavista bean	(WB)	20.62
3	Creamy Fodder cow pea	(CFC)	20.31
4	Dotted Fodder cow pea	(DFC)	18.89
5	Brown Fodder cow pea	(BRFC)	18.40
6	Black Bonavista bean	(BB)	16.43
7	Pearl millet + Dotted Fodder cow pea	(PM + DFC)	12.09
8	Pearl millet + Brown Fodder cow pea	(PM +BRFC)	11.99
9	Pearl millet + Creamy Fodder cow pea	(PM + CFC)	11.80
10	Pearl millet + Brown Bonavista bean	(PM + BRB)	10.66
11	Pearl millet + White Bonavista bean	(PM + WB)	9.98
12	Pearl millet	(PM)	9.73
13	Pearl millet + Black Bonavista bean	(PM + BB)	9.65
	L.S.D at: 5 % for :		T= 1.27

Crude fiber (CF) content

Results of the combined analysis indicate significant differences in CF content among the studied Bonavista bean types (Table 29). The Brown type was of the highest significant crude fiber (CF) content (32.69%), whereas, White and Black Bonavista bean produced almost similar CF content which was 29.25 and 30.50%, respectively. So, the Brown type was of about 12% higher in CF content as compared with the other two types (White and Black).In other words, White type of B.bean proved to be the lowest in CF content compared with Black and Brown types where there was appreciable difference in CF content between the latter two types.

Seasonal variations indicated significant difference in CF content among the tested Bonavista bean types (Table 29). Results clarified that Brown type of Bonavista bean

Table (28): Crude protein (CP) content of the studied forage legumes and pearl millet in their pure stands and relevant mixtures.

Pure & Mixtures Forages*		First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
		........................(% on dry matter basis)........................								
Pure stands	PM	10.11	7.66	8.88	10.80	10.35	10.57	10.46	9.0	9.73
	WB	20.52	18.77	19.64	23.40	19.80	21.60	21.96	19.28	20.62
	BB	19.20	16.39	17.80	16.65	13.50	15.07	17.93	14.95	16.43
	BRB	19.25	17.81	18.53	24.98	22.16	23.57	22.12	19.98	21.05
	CFC	20.21	17.81	19.01	22.95	20.25	21.60	21.58	19.03	20.31
	BRFC	17.81	15.40	16.60	21.38	19.01	20.20	19.60	17.20	18.40
	DFC	19.73	17.33	18.53	20.59	17.89	19.24	20.16	17.61	18.89
Relevant mixtures (50 + 50 %)	PM +WB	10.59	8.18	9.39	11.59	9.56	10.57	11.09	8.87	9.98
	PM + BB	8.18	7.22	7.70	11.59	11.59	11.59	9.88	9.41	9.65
	PM + BRB	10.59	10.11	10.35	12.71	9.23	10.97	11.65	9.67	10.66
	PM + CFC	12.51	9.14	10.83	13.16	12.38	12.77	12.84	10.76	11.80
	PM+BRFC	10.59	9.14	9.86	15.86	12.38	14.12	13.22	10.76	11.99
	PM +DFC	11.55	10.59	11.07	13.50	12.71	13.10	12.53	11.65	12.09
LSD at: 5% for:		F= 1.26	F= 1.27	F=1.26	F= 2.28	F= 2.28	F= 2.28	F= 1.27, FY= 1.79	F= 1.27, FY= 1.79	F= 1.27, FY= 1.79

* PM = Pearl millet, WB = White Bonavista bean, BB = Black Bonavista bean, BRB = Brown Bonavista bean, CFC= Creamy Fodder cow pea. BRFC = Brown Fodder cow pea, DFC = Dotted Fodder cow pea.

was significantly the highest (32.69 %) in CF content compared to each of other two types either White (29.25 %) or Black (30.50 %). This result was true in the first growing season. But, Black Bonavista bean type was higher than Brown type in CF without significant differences in between during the second season (Table 29).

In this respect, the combined analysis proved that CF content was generally higher in the second cuts than the first one for all of the tested Bonavista bean types with significant different magnitudes. The superiority in CF content of Brown type compared with the other two types was 13% in the first cuts and 11 % in the second cuts. Whereas, the differences between the White and Black types were significantly

different in the first cut. But, were found insignificant differences during the second cuts (Table 29).

It is also noticed that all of the three tested B.bean types produced relatively slight higher CF content in the second season than the first season. This result could be due to the relatively higher ambient temperature under the circumstances of the second season as compared with the previous season as presented in Table (2-b).

It could be more likely for Fodder cowpea types that CF content (from the combined analysis) showed significant differences within the three tested indigenous native F.cowpea types (Table 33).Whereas, similar trend was noticed for cowpeas type in their CF content among the seasonal variations, where the higher CF content was noticed during the second season rather than the first one. This case was quite similar for Bonavista bean types previously presented.

Data in Table (29) of the combined analysis proved that all of the three types of Fodder cowpea evidenced significant higher increase in CF content during the second cuts as compared with the first ones with almost similar magnitudes. Whereas, Bonavista bean types behaved in similar trend as for Fodder cowpea types previously presented and discussed (Table 29).

Regarding the overall comparisons between all of the tested six types of indigenous native legumes, the combined analysis clarified that each of the Brown and Creamy types of fodder cowpea was higher in CF content as compared with any of the tested Bonavista bean types (Table 29). These results confirm the more crude fiber content of F.cowpea types than Bonavista bean types.

Moreover, Brown type of Bonavista bean was of more CF content than the other two types (Black and White type) with significant differences. However, Fodder cowpea types were of appreciable differences magnitudes in their CF content. Where the respective CF content could be presented in the following descending order: Brown, Creamy and Dotted cowpea. Seasonal variations indicated more CF content in the second season than the first one, with slight ignorable differences.

It is generally noticed that CF content was higher in the second season than the first one with significant differences. The descending ranking order of CF was as follow: Brown cowpea > Creamy cowpea> Brown B.bean > Dotted cowpea > Black B.bean > White B.bean. From such ranking order Brown Fodder cowpeas type was the most CF content during each of the two cuts and White type was of the lowest CF during the first cut. Whereas, Black Bonavista beans was the least in CF for the second cut. Brown Fodder cowpea type was 21 % higher in CF content as compared with the White Bonavista bean type for the first cut. Moreover, Brown Fodder cowpea type was higher in CF content with about 24 % than Black type for the second cut.

Results of the combined analysis proved that in mixtures CF content of pearl millet with any of the six Fodder legumes could be ranked in the following descending order: PM+BB $_{(34.94\%)}$ > PM+CFC $_{(33.81\%)}$ > PM+WB $_{(32.81\%)}$ > PM+BrB $_{(32.13\%)}$ > PM+DFC $_{(31.99\%)}$ > PM+BrFC $_{(31.25\%)}$ within each of the subsequent order with some significant differences in between as shown in Table (29).It is more likely recommended that mixing Pearl millet (PM) + Black Bonavista bean (BB) and Pearl millet (PM) + Creamy Fodder cowpea (CFC) were of the best combinations regarding CF content.

From the combined analysis (Table 29), it is also clear that CF content of the proposed mixtures was much more in CF during the second season compared with the first one with significant differences.

It looks to be true that there was a significant difference in CF content for the later than the previous cuts with different behaviour among the grown mixtures. The currently presented results of the behaviour of CF content of fodder crops and their mixtures were more or less similar to those reported by **Abd El Gawad *et al.* (1992)** for Sudan grass with cowpea, **Mohamed (1992)** for Sudan grass with cowpea and **Abd El-Salam (2002)** mixtures for Pearl millet with cowpea.

It should be pointed out that the mixtures of Fodder cowpea types were of higher CF content during the second cuts compared with the first ones. Bonavista bean types were also higher in CF content of its relevant mixture with millet compared with any

of grown tested types of fodder cowpeas and for the latest than the earliest cuts as well.

It looks to be true that either of Bonavista beans or Fodder cowpeas as a leguminous crops produced higher CF content in the second than the first cuts in generally.

So, it could be concluded that for any of the tested indigenous native forage legumes, their second cuts were of more CF content than the first cuts. This may clarify the similarity of vegetative growth for such types of legumes as affected by the prevailing environmental conditions which could be quite different during the earlier than the later days of summer season.

For the sake of comparison of the CF content for mixtures with their relevant pure stand components assuming cropping in a similar land unit area, could be presented as follows:

Mixtures product (%)	**Actual production in pure stands** (%)	**% of increase for each component of the related mixtures**
Actual production of mixtures (50:50%)	Pearl millet + legumes	PM + legumes
PM + BB (34.94)	31.87 + 30.50	10 + 15 %
PM + CFC (33.81)	31.87 + 33.56	6 + 0.7 %
PM + WB (32.81)	31.87 + 29.25	3 + 12 %
PM + BrB (32.13)	31.87 + 32.69	0.8 + 1.7 %
PM + DFC (31.99)	31.87 + 32.13	0.4 + 0.4%
PM + BrFC (31.25)	31.87 + 35.25	2 + 13 %

The descending ranking order of the crude fiber (CF) content for the grown forage mixtures and their relevant pure stands are presented in the following comparative set of data:

NO.	Treatments		Crude fiber content (%)
1	Brown Fodder cow pea	(BRFC)	35.25
2	Pearl millet + Black Bonavista bean	(PM + BB)	34.94
3	Pearl millet + Creamy Fodder cow pea	(PM + CFC)	33.81
4	Creamy Fodder cow pea	(CFC)	33.56
5	Pearl millet + White Bonavista bean	(PM + WB)	32.81
6	Brown Bonavista bean	(BRB)	32.69
7	Pearl millet + Brown Bonavista bean	(PM + BRB)	32.13
8	Dotted Fodder cow pea	(DFC)	32.13
9	Pearl millet + Dotted Fodder cow pea	(PM + DFC)	31.99
10	Pearl millet	(PM)	31.87
11	Pearl millet + Brown Fodder cow pea	(PM +BRFC)	31.25
12	Black Bonavista bean	(BB)	30.50
13	White Bonavista bean	(WB)	29.25
	L.S.D at: 5 % for :		T= 1.43

Ash content

In comparing ash content of pure Bonavista bean types, the combined analysis clarified that the White type was of the highest significant ash content (12.50 %), whereas, Brown and Black Bonavista bean produced almost similar ash content which was 11.88 and 11.63 %, respectively. So, the White type was of about 8 % higher in ash content as compared with the other two types (Brown and Black).In other words, White type of B.bean proved to be the highest in ash content compared with Brown and Black types where there was no appreciable significant difference in ash content between the later two types (Table 30).

Seasonal variations exerted significant difference in ash content among the tested Bonavista bean types. Results showed that White type was significantly the highest in

Table (29): Crude fiber (CF) content of the studied forage legumes and pearl millet in their pure stands and relevant mixtures.

	Pure & Mixtures Forages*	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
		......................(% on dry matter basis)......................								
Pure stands	PM	29.0	32.0	30.5	33.25	33.25	33.25	31.12	32.62	31.87
	WB	24.75	29.25	27.0	31.0	32.0	31.50	27.87	30.62	29.25
	BB	27.50	28.25	27.87	31.75	34.50	33.12	31.37	29.62	30.50
	BRB	32.75	34.25	33.5	30.0	33.75	31.87	31.37	34.0	32.69
	CFC	32.0	32.0	32.0	33.50	36.75	35.12	32.75	34.37	33.56
	BRFC	34.0	36.0	35.0	33.25	37.75	35.50	33.62	36.87	35.25
	DFC	26.0	32.0	29.0	34.0	36.50	35.25	30.0	34.25	32.13
Relevant mixtures (50 + 50 %)	PM + WB	29.0	28.75	28.87	36.50	37.0	36.75	33.0	32.62	32.81
	PM + BB	32.50	33.50	33.0	35.75	38.0	36.87	34.12	35.75	34.94
	PM + BRB	28.0	33.50	30.75	32.0	35.0	33.50	30.0	34.25	32.13
	PM + CFC	30.50	30.75	30.62	33.0	41.0	37.0	31.75	35.87	33.81
	PM+ BRFC	27.25	30.50	28.87	32.75	34.0	33.87	30.0	32.50	31.25
	PM + DFC	28.70	31.0	29.85	30.50	37.75	34.12	29.60	34.37	31.99
LSD at: 5% for:		F= 0.63	F=1.11	F= 0.32	F=2.61	F=3.87	F=2.87	F=1.31, FY=1.85	F=1.96, FY= 2.77	F=1.43, FY= 2.03

* PM = Pearl millet, WB = White Bonavista bean, BB = Black Bonavista bean, BRB = Brown Bonavista bean, CFC= Creamy Fodder cow pea, BRFC = Brown Fodder cow pea, DFC = Dotted Fodder cow pea.

ash content compared to each of other two types (Brown and Black). Meanwhile, Black type was the lowest in ash content. This result was true in each of the two growing seasons with significant differences.

It seems to be true that the combined analysis proved that ash content was generally higher in the first cuts than the second ones for all of the tested Bonavista bean types with slight different significant magnitudes. The superiority in ash content of White type compared with the other two types was 11 % in the first cuts and 4 % in the second cuts. Whereas, the Brown and Black types did not exert appreciable differences in between during each of the two cuts.

It is also noticed that all of the three tested B.bean types produced relatively slightly higher ash content in the second season than the first cuts. This result could be due to the slight warmer summer of the second season as compared with the previous season as it is recorded in Table (2-b).

In comparing the ash content of pure Fodder cowpea types, the combined analysis exerted significant differences within the three tested indigenous native F.cowpea types (Table 30).Whereas, different trend was noticed for cowpea types in their ash content among the seasonal variations, where the higher ash content was noticed during the first season rather than the second season. This case was quite different than for B.bean types previously presented. Such obtained resulted indicate that B.bean types are of more stimulated growth during warmer summer season than cowpeas as presented previously.

It is also clear that some of the presented results of cowpea types in the first cuts were more or less similar to what was noticed in the second one, but without significant difference and some odd fluctuations. These could be due to some variation in some of the prevailing environmental conditions (Table 2-b)

Regarding the overall comparisons between all of the tested six types of indigenous native legumes, the combined analysis clarified that each of the Creamy and Brown types of fodder cowpea was higher in ash content as compared with any of the tested Bonavista bean types (Table 30). These results confirm the more ash content of F.cowpea types than Bonavista bean types.

Moreover, the White type of Bonavista bean was of more ash content than the other two types. (Brown and Black type) with significant differences. However, Fodder cowpea types were of higher content. However, the respective ash could be presented in the following descending order in Creamy, Brown and Dotted cowpea.

Seasonal variations indicated more ash content in the first season than the second one, with slight ignorable differences. It is generally noticed that ash content was higher in the second season than the first one with ignorable slight significant differences. The

descending ranking order of ash content in pure stand of forage legumes was as follow: Creamy cowpea > Brown cowpea > Dotted cowpea > White B.bean > Brown B.bean > Black B.bean in their pure stands. From such ranking order Creamy and Brown Fodder cowpea types were of the most ash content during the first and second cuts, respectively. Meanwhile, Black Bonavista bean were of the lowest ash content during each of the two cuts. But the Creamy Fodder cowpeas type was 13 % higher in ash content as compared with the Black Bonavista bean type during the first cut. Moreover, Brown Fodder cowpea type was higher in ash content with about 13 % than Black Bonavista bean type during the second cut.

Results of the combined analysis clarified that in mixtures ash content of pearl millet with any of the six fodder legumes could be ranked in the following descending order: PM+BrFC $_{(12.38\%)}$>PM+BB $_{(12.13\%)}$ > PM+DFC $_{(11.75\%)}$ >PM+CFC (11.50%) =PM+BrB $_{(11.50\%)}$ >PM+WB $_{(11.38\%)}$ within each of the subsequent order with some significant differences in between as shown in Table (30).

It is more likely recommended that mixtures of Pearl millet (PM) + Brown Fodder cowpea (BrFC) and Pearl millet (PM) + Black Bonavista bean (BB) were of the best combinations regarding ash content.

From the combined analysis (Table 30), it is also clear that ash content of the proposed mixture was much more during the second season compared with the first one with significant differences for fodder cowpea types. Meanwhile, an opposite trend was noticed for Bonavista bean types during the second season as compared with the first one with slight significant differences.

The currently presented results of the behaviour of ash content of fodder crops and their mixtures were more or less similar to those reported by **Abd El-Aal (1991)** for mixtures of sordan with guar and **Abd El-Salam (2002)** for Pearl millet with cowpea.

It should be pointed out that the mixtures of fodder cowpea types were of higher ash content during the first cuts compared with the second cuts. Bonavista bean types were

also higher in ash content of its mixture with millet compared with any of grown tested types of fodder cowpeas for the earliest than the latest cuts. It looks to be true that either Bonavista beans or Fodder cowpeas types as a herbaceous leguminous crops produced higher ash content in the first than the second cuts in general. So, it could be concluded that for any of the tested indigenous native forage legumes, their first cuts were of more ash content than the second cuts. This may clarify the similarity of vegetative growth for such types of legumes as affected by the prevailing environmental conditions which could be quite different during the earlier than the latter cuts.

For clear cut comparison, the ash content for mixtures with their relevant pure stand components assuming cropping in a similar land unit area could be as follows:

Mixtures product (%)	**Actual production in pure stands** (%)	**% of increase for each component of the related mixtures**
Actual production of mixtures (50:50%)	Pearl millet + legumes	PM + legumes
PM + BrFC (12.38)	11.38 + 12.75	8.8 + 3 %
PM + BB (12.13)	11.38 + 11.63	6.6 + 4.3 %
PM + DFC (11.75)	11.38 + 12.75	3.2 + 8.5 %
PM + CFC (11.50)	11.38 + 13.00	1.0 + 13 %
PM + BrB (11.50)	11.38 + 11.88	1.0 + 3.3%
PM + WB (11.38)	11.38 + 12.50	0.0 + 9.8 %

The descending ranking order of the ash content for the grown forage mixtures and their relevant pure stands in the following comparative set of data:

NO.	Treatments		Ash content (%)
1	Creamy Fodder cow pea	(CFC)	13.0
2	Dotted Fodder cow pea	(DFC)	12.75
3	Brown Fodder cow pea	(BRFC)	12.75
4	White Bonavista bean	(WB)	12.50
5	Pearl millet + Brown Fodder cow pea	(PM + BRFC)	12.38
6	Pearl millet + Black Bonavista bean	(PM + BB)	12.13
7	Brown Bonavista bean	(BRB)	11.88
8	Pearl millet + Dotted Fodder cow pea	(PM + DFC)	11.75
9	Black Bonavista bean	(BB)	11.63
10	Pearl millet + Brown Bonavista bean	(PM + BRB)	11.50
11	Pearl millet + Creamy Fodder cow pea	(PM + CFC)	11.50
12	Pearl millet + White Bonavista bean	(PM + WB)	11.38
13	Pearl millet	(PM)	11.38
	L.S.D at: 5 % for :		T= 0.30

Ether extract (EE) content

In comparing the ether extract (EE) content of pure Bonavista bean types, the combined analysis showed that Brown type was of the highest significant EE content (3.79 %); whereas, White and Black Bonavista bean produced similar EE content which was 3.65 % for each of the two types. So, the Brown type was of about 3.8 % higher in EE content as compared with the other two types (White and Black), where they did not show significant difference in EE between the later two types (Table 31).

Seasonal variations exerted significant difference in EE content among the tested Bonavista bean types (Table 31). Data indicated that Brown type was significantly the highest in EE content compared to each of other two types (Black and White). Meanwhile, Black and White types were lowest in EE content. This result was true in the first and second growing seasons without significant differences (Table 31).

Table (30): Ash content of the studied forage legumes and pearl millet in their pure stands and relevant mixtures.

Pure & Mixtures Forages*		First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
		......................(% on dry matter basis)......................								
Pure stands	PM	12.0	*10.0*	11.0	11.50	12.0	11.75	11.75	*11.0*	11.38
	WB	13.0	11.50	12.25	13.0	12.50	12.75	13.0	12.0	12.50
	BB	11.0	11.0	11.0	12.50	12.0	12.25	11.75	11.50	11.63
	BRB	11.0	11.50	11.25	12.50	12.0	12.25	12.0	11.75	11.88
	CFC	13.50	13.50	13.50	13.0	12.0	12.50	13.25	12.75	13.0
	BRFC	12.0	13.0	12.50	13.0	13.0	13.0	12.50	13.0	12.75
	DFC	12.50	13.50	13.0	13.0	12.0	12.50	12.75	12.75	12.75
Relevant mixtures (50 + 50 %)	PM + WB	12.0	10.50	11.25	11.0	12.0	11.50	11.50	11.25	11.38
	PM + BB	12.0	12.0	12.0	12.0	12.50	12.25	12.0	12.25	12.13
	PM + BRB	12.50	10.0	11.25	11.50	12.0	11.75	12.0	11.0	11.50
	PM + CFC	13.0	11.50	12.25	11.0	10.50	10.75	12.0	11.0	11.50
	PM+BRFC	13.50	12.0	12.75	11.0	13.0	12.0	12.25	12.50	12.38
	PM + DFC	13.50	11.50	12.50	11.0	11.0	11.0	12.25	11.25	11.75
LSD at: 5% for:		F= 0.61	F= 0.81	F= 0.53	F= 0.48	F= 0.36	F= 0.31	F= 0.38, FY= 0.54	F= 0.43, FY= 0.61	F= 0.30, FY= 0.42

*** PM = Pearl millet, WB = White Bonavista bean, BB = Black Bonavista bean, BRB = Brown Bonavista bean, CFC= Creamy Fodder cow pea, BRFC = Brown Fodder cow pea, DFC = Dotted Fodder cow pea.**

It should be pointed out that the combined analysis showed that EE content was generally higher in the second cuts than the first ones for all of the tested Bonavista bean types with different significant magnitudes. The EE content of Brown type was higher as compared with the other two types (White and Black) where they did not exert appreciable differences in between during each of the two cuts.

It is also noticed that all of the three tested Bonavista bean types produced slightly higher EE content in the second season than the first one. This result could be due to the warmer summer of the second season as compared with the first season as shown in Table (2-b).

In comparing the EE content of pure Fodder cowpea types, the combined analysis showed significant differences within the three tested indigenous native F.cowpea types.

It is also clear that the presented results of cowpea types in the first cuts were slightly high in EE content than what was noticed in the second one, but without significant difference and with some odd fluctuations. These could be due to its specific genetical makeup and its interaction with the prevailing environmental conditions.

Regarding the overall comparisons between all of the tested six types of indigenous native legumes, the combined analysis showed that each of the tested Fodder cowpea types were higher in EE content as compared with any of the tested B.bean types in their pure stands (Table31).

Moreover, Brown type of Bonavista bean was more in EE content type than the other two types (White and Black type) with significant differences. Whereas, the respective ether extract could be presented in the following descending order: Creamy cowpea, Dotted cowpea and Brown cowpea.

It is generally noticed that EE content was higher in the second season than the first season with ignorable slight significant differences. The descending ranking order of EE was as follow for Creamy cowpea, Dotted cowpea, Brown cowpea, Brown Bonavista bean, Black Bonavista bean and White Bonavista bean in their pure stands. From such ranking order Creamy and Dotted Fodder cowpea types were of the most EE content during the first and second cuts. Meanwhile, White and Black Bonavista bean were of the lowest EE during each of the two cuts. But the Creamy Fodder cowpeas type was 33 % higher in EE content as compared with the White Bonavista bean during the first cut. Moreover, Dotted Fodder cowpea type was higher in EE content with about 9 % than Black B.bean type during the second cut.

Results of the combined analysis showed that in mixtures, EE content of pearl millet with any of the six Fodder legumes could be ranked in the following descending order: PM–BrB $_{(3.16\%)}$>PM+BrFC $_{(3.06\%)}$ > PM+DFC $_{(3.02\%)}$ >PM–CFC (3.0%) >PM–WB

$_{(2.93\%)}$ >PM+BB $_{(2.57\%)}$ within each of the subsequent order with some significant differences in between as shown in Table (31).

It is more likely recommended that mixing Pearl millet (PM) + Brown Bonavista bean (BrB) and Pearl millet (PM) + Brown Fodder cowpea (BrFC) were of the best combinations regarding EE content.

From the combined analysis (Table 31), it is also clear that EE content of the proposed mixture was much more in EE content during the second season compared with the first season with significant differences.

It looks to be true that there was a significant difference in EE content for the later than the earlier cuts with different behaviour among the grown mixtures. The currently presented results of the behaviour of EE content of fodder crops and their mixtures were more or less similar those reported by **Abd El-Aal (1991)** for mixture of sordan with guar and **Abd El-Salam (2002)** for Pearl millet with cowpea.

It is well noticed that in mixtures with pearl millet, Fodder cowpea types were of higher EE content during the second cuts compared with the first cuts. This result was not true in case of Fodder cowpea types which were grown for its own pure stands.

Bonavista bean types were also higher in EE content of its mixture with millet at any of grown tested types of Fodder cowpea for the latest than the earliest cuts.

It looks to be true that either of Bonavista beans or Fodder cowpeas as a herbaceous leguminous crops produced higher EE content in the second than the first cuts, in general.

Ether extract content for mixtures with their relevant pure stand components assuming cropping in a similar land unit area could recognize the following EE distribution:

Mixtures product (%)	Actual production in pure stands (%)	% of increase for each component of the related mixtures
Actual production of mixtures (50:50%)	Pearl millet + legumes	PM + legumes
PM + BrB (3.16)	2.97 + 3.79	6.4 + 20 %
PM + BrFC (3.06)	2.97 + 4.04	3.0 + 32 %
PM + DFC (3.02)	2.97 + 4.12	1.7 + 36 %
PM + CFC (3.00)	2.97 + 4.31	1.0 + 10 %
PM + WB (2.93)	2.97 + 3.65	1.4 + 24.6 %
PM + BB (2.57)	2.97 + 3.65	15.6 + 42 %

The descending ranking order of the ether extract (EE) content for the grown forage mixtures and their relevant pure stands in the following comparative set of data:

NO.	Treatments		Ether extract content (%)
1	Creamy Fodder cow pea	(CFC)	4.31
2	Dotted Fodder cow pea	(DFC)	4.12
3	Brown Fodder cow pea	(BRFC)	4.04
4	Brown Bonavista bean	(BRB)	3.79
5	Black Bonavista bean	(BB)	3.65
6	White Bonavista bean	(WB)	3.65
7	Pearl millet + Brown Bonavista bean	(PM + BRB)	3.16
8	Pearl millet + Brown Fodder cow pea	(PM +BRFC)	3.06
9	Pearl millet + Dotted Fodder cow pea	(PM + DFC)	3.02
10	Pearl millet + Creamy Fodder cow pea	(PM + CFC)	3.0
11	Pearl millet + White Bonavista bean	(PM + WB)	2.93
12	Pearl millet	(PM)	2.67
13	Pearl millet + Black Bonavista bean	(PM + BB)	2.57
	L.S.D at: 5 % for :		T= 0.14

Table (31): Ether extract (EE) content of the studied forage legumes and pearl millet in their pure stands and relevant mixtures.

Pure & Mixtures Forages*		First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
		......................(% on dry matter basis)......................								
Pure stands	PM	2.25	*2.60*	2.42	2.80	3.05	2.92	2.52	*2.82*	2.67
	WB	3.10	3.60	3.35	3.80	4.10	3.95	3.45	3.85	3.65
	BB	3.30	3.30	3.30	3.85	4.15	4.0	3.57	3.72	3.65
	BRB	3.20	3.80	3.50	3.90	4.25	4.07	3.55	4.02	3.79
	CFC	3.90	3.90	3.90	5.30	4.15	4.72	4.60	4.02	4.31
	BRFC	3.50	3.80	3.65	5.10	3.75	4.42	4.30	3.77	4.04
	DFC	3.25	3.90	3.58	5.10	4.25	4.67	4.17	4.07	4.12
Relevant mixtures (50 + 50 %)	PM +WB	2.60	3.15	2.88	3.10	2.85	2.98	2.85	3.0	2.93
	PM + BB	2.50	3.60	3.05	2.95	3.25	3.10	2.72	3.42	2.57
	PM + BRB	*2.90*	*3.10*	*3.0*	*2.90*	*3.70*	*3.32*	*2.92*	*3.40*	*3.16*
	PM + CFC	2.70	3.0	2.85	3.0	3.30	3.15	2.85	3.15	3.0
	PM+BRFC	2.20	3.10	2.65	3.55	3.40	3.48	2.87	3.25	3.06
	PM + DFC	2.40	3.10	2.75	3.30	3.30	3.30	2.85	3.20	3.02
LSD at: 5% for:		F= 0.31	F= 0.13	F= 0.17	F=0.30	F= 0.28	F= 0.24	F= 0.21, FY= 0.30	F= 0.15, FY= 0.21	F= 0.14, FY= 0.20

* PM = Pearl millet, WB = White Bonavista bean, BB = Black Bonavista bean, BRB = Brown Bonavista bean, CFC= Creamy Fodder cow pea, BRFC = Brown Fodder cow pea, DFC = Dotted Fodder cow pea.

Nitrogen free extract (NFE) content

Results in Table (32) represent nitrogen free extract (NFE) content of Bonavista bean types in their pure stands. The combined analysis clarified that Black type was of the highest significant NFE content (37.79 %), whereas, Brown and White Bonavista bean produced almost similar NFE content which was 30.60 and 33.98 % respectively. So, the Black type was of about 23.5 % higher in NFE content as compared with the other two types (Brown and White) where they exerted slight significant difference in NFE content between the later two types (Table 32).

Seasonal variations exerted significant difference in NFE content among the tested Bonavista bean types. This result was true in the first and second growing seasons without significant differences during the second season (Table 32).

It looks to be true that the combined analysis showed that NFE content was generally higher in the first cuts than the second ones for all of the tested Bonavista bean types with different significant magnitudes. The superiority in NFE content of Black type compared with the other two types (Brown and White) did not exert significant differences in between during the second cuts (Table 32).

It is also clear that all of the three tested Bonavista bean types produced relatively slightly higher NFE content in the first season than the second one. In general, seasonal variations indicated more NFE content in the first season than the second one with slight differences.

Also, in comparing the NFE content of pure fodder cowpea types, combined analysis showed slight significant differences between the three tested indigenous native F.cowpea types (Table 32). It is also noticed that the presented results of NFE content of cowpea types in the first cuts were relatively higher than the second cuts, but without significant difference (Table 32).

Regarding the overall comparisons between all of the tested six types of indigenous native legumes in their pure stands, the combined analysis indicated that Black and White Bonavista bean types was higher in NFE content as compared with any of the tested three Fodder cowpea types (Table 32).

Moreover, Black type of B.bean was of more NFE content than the other two Bonavista bean types. (White and Brown type) with significant differences. Whereas, the respective NFE could be presented in the following descending order: Dotted cowpea, Creamy cowpea and Brown cowpea.

In pure stands, the descending ranking order of NFE was as follow: Black Bonavista bean > White Bonavista bean > Dotted cowpea > Brown Bonavista bean > Brown cowpea > Creamy cowpea. From this ranking order Black Bonavista bean was of the

highest NFE content during the first and second cuts. Meanwhile, Creamy Fodder cowpea type was of the lowest NFE during each of the two cuts. But the Black B.bean type was 27 % and 36 % higher in NFE content as compared with the Creamy Fodder cowpeas type for each of the two respective cuts.

Data of the combined analysis showed that in mixtures, NFE content of pearl millet mixed with any of the six Fodder legumes could be ranked in the following descending order: PM+ WB $_{(42.91\%)}$>PM+ BrB $_{(42.55\%)}$ > PM+ BrFC $_{(41.32\%)}$ >PM+ DFC (41.15%) >PM+ BB $_{(40.22\%)}$ >PM+ CFC $_{(39.89\%)}$ within each of the subsequent order with some significant differences in between as shown in Table (32).

It could be recommended that mixtures of Pearl millet (PM) + White Bonavista bean (WB) and Pearl millet (PM) – Brown Bonavista bean (BrB) were the best combinations regarding NFE content. From the combined analysis, it is also clear that NFE content of the proposed mixture was much higher in NFE content during the first season compared with the second one with significant differences.

It is clear that there was significant difference in NFE content for the earlier than the later cuts with different behaviour among the grown mixtures. The currently presented results of the behaviour of NFE of fodder crops and their mixtures were more or less similar to those reported by **Abd El-Aal (1991)** on sordan with guar mixture and **Mohamed (1992)** on Sudan grass with cowpea.

It is well noticed that mixtures with Fodder cowpea types were of higher nitrogen free extract (NFE) content during the first cuts compared with the second ones. Similar trend was noticed when Fodder cowpea types were grown for its own pure stands. Bonavista bean types were also higher in nitrogen free extract content for its mixture with millet as compared with any of grown tested types of Fodder cowpeas in the mixtures. Either Bonavista beans or Fodder cowpeas as a leguminous forage crops produced higher NFE content in the first than the second cuts in general. In comparison, nitrogen free extract (NFE) content for mixtures with their relevant pure stand components(assuming cropping in a similar land unit area) results could be presented as follows:

Mixtures product (%)	Actual production in pure stands (%)	% of increase for each component of the related mixtures
Actual production of mixtures (50:50%)	Pearl millet + legumes	PM − legumes
PM − WB (42.91)	44.34 − 33.98	3.3 + 26.3 %
PM + BrB (42.55)	44.34 − 30.60	7.3 + 39.8 %
PM + BrFC (41.32)	44.34 + 29.56	4.2 + 39 %
PM + DFC (41.15)	44.34 + 32.11	7.8 + 28 %
PM − BB (40.22)	44.34 + 37.79	10.2 − 6.4%
PM + CFC (39.89)	44.34 − 28.82	11.2 + 38.4 %

The descending ranking order of nitrogen free extract (NFE) content for the grown forage mixtures and their relevant pure stands is presented in the following comparative set of data:

NO.	Treatments		Nitrogen free extract content (%)
1	Pearl millet	(PM)	44.34
2	Pearl millet + White Bonavista bean	(PM + WB)	42.91
3	Pearl millet + Brown Bonavista bean	(PM − BRB)	42.55
4	Pearl millet + Brown Fodder cow pea	(PM + BRFC)	41.32
5	Pearl millet + Dotted Fodder cow pea	(PM + DFC)	41.15
6	Pearl millet + Black Bonavista bean	(PM − BB)	40.22
7	Pearl millet + Creamy Fodder cow pea	(PM − CFC)	39.89
8	Black Bonavista bean	(BB)	37.79
9	White Bonavista bean	(WB)	33.98
10	Dotted Fodder cow pea	(DFC)	32.11
11	Brown Bonavista bean	(BRB)	30.60
12	Brown Fodder cow pea	(BRFC)	29.56
13	Creamy Fodder cow pea	(CFC)	28.82
	L.S.D at: 5 % for :		T= 1.85

Table (32): Nitrogen free extract (NFE) content of the studied forage legumes and pearl millet in their pure stands and relevant mixtures.

Pure & Mixtures Forages*		First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
		......................(% on dry matter basis)......................								
Pure stands	PM	46.64	*47.74*	47.19	42.10	40.90	42.50	44.37	*44.32*	44.34
	WB	38.63	36.88	37.75	32.40	28.0	30.20	35.52	32.44	33.98
	BB	38.25	41.81	40.03	35.65	35.45	35.55	36.95	38.63	37.79
	BRB	33.30	32.64	32.97	28.62	27.84	28.23	30.96	30.24	30.60
	CFC	30.39	32.79	31.59	27.95	24.15	26.05	29.17	28.47	28.82
	BRFC	32.69	31.80	32.24	27.27	26.49	26.88	29.98	29.15	29.56
	DFC	38.52	33.27	35.89	30.01	26.66	28.33	34.26	29.96	32.11
Relevant mixtures (50 + 50 %)	PM +WB	45.81	49.42	47.61	39.34	37.06	38.20	42.58	43.24	42.91
	PM + BB	44.82	43.68	44.25	37.71	34.66	36.18	41.26	39.17	40.22
	PM + BRB	46.01	43.29	44.65	44.32	36.59	40.46	45.16	39.94	42.55
	PM + CFC	41.29	45.61	43.45	39.84	32.82	36.33	40.57	39.21	39.89
	PM+ BRFC	46.46	45.26	45.86	40.32	33.24	36.78	43.39	39.25	41.32
	PM + DFC	44.81	42.85	43.83	41.70	35.24	38.47	43.26	39.05	41.15
LSD at: 5% for:		F= 0.83	F= 1.75	F= 0.47	F= 2.95	F= 4.88	F= 3.68	F= 1.49, FY= 2.11	F= 2.52, FY= 3.56	F= 1.85, FY= 2.62

*PM = Pearl millet, WB = White Bonavista bean, BB = Black Bonavista bean, BRB = Brown Bonavista bean, CFC= Creamy Fodder cow pea, BRFC = Brown Fodder cow pea, DFC = Dotted Fodder cow pea.

Nutritive value

A-Total digestible nutrients (TDN) content

In comparing the total digestible nutrients (TDN) content of pure stands of Bonavista bean types, the combined analysis showed that White type was of the highest significant TDN content (60.30 %), which was of about 4 % higher in TDNcontent as compared with each of the other two Bonavista bean types (Brown & Black). Whereas, Brown and Black types produced almost similar TDN content which was 57.94 and 57.92 %, respectively without significant differences in between (Table 33).

Seasonal variations exerted significant difference in total digestible nutrients content among the tested Bonavista bean types (Table 33). It should be pointed out that combined analysis proved that TDN content was generally higher in the first cuts than the second cuts for all of the tested Bonavista bean types with significant differences. The superiority in TDN content of White Bonavista bean type compared with the other two types was 6.8 % in the first cuts and 5 % in the second cuts (Table 33).It is also noticed that all of the three tested B.bean types produced slightly higher TDN content in the first season than the second one.

In comparing TDN content of pure Fodder cowpea types, the combined analysis exerted significant differences within the three tested indigenous native F.cowpea types (Table 33).Whereas, Dotted type of Fodder cowpea was significantly the highest in TDN content compared to each of other two types (Creamy and Brown) during the first season. Meanwhile, Creamy type of Fodder cowpea was significantly the highest in TDN content compared to each of other two types (Brown and Dotted) during the second season (Table 33).

Data in Table (33) of the combined analysis proved that all of the three types of Fodder cowpea evidence significant higher reduction in TDN content during the second cuts as compared with the first ones with almost similar magnitudes. This result could be due to the noticed higher rust infection and lower shooting rates as well as reduction of growth. However, Bonavista bean types behaved in similar trend as for Fodder cowpea types previously presented and discussed (Table 33).

Among the overall comparisons between all of the tested six types of indigenous native legumes in their pure stands, the combined analysis showed that each of the White and Brown types of Bonavista bean was higher in TDN as compared with any of the tested Fodder cowpea types (Table 33). These results confirm the more TDN content of Bonavista bean types as compared with F.cowpea types.

Moreover, White type of Bonavista bean was of more TDN content than the other two Bonavista bean types (Brown and Black type) with significant differences. Moreover, Fodder cowpea types were of slight differences in their TDN content. However, the

respective TDN content could be presented in the following descending order: Dotted cowpea, Creamy cowpea and Brown cowpea. Whereas, there was of no appreciable differences between the earlier two types of Fodder cowpea.

Seasonal variations showed more TDN content in the first season than the second one, with slight ignorable differences.

It is generally noticed that TDN content was higher in the first season than the second one with significant differences. In pure stands, the descending ranking order of TDN content was as follow: White B.bean, Brown B.bean, Black B.bean, Dotted cowpea, Creamy cowpea then Brown cowpea. From such ranking order White Bonavista bean type was of the highest TDN content during each of the two cuts, and Brown Fodder cowpea of the lowest TDN content during each of the two cuts. Whereas, there was about 7.7 % and 11 % higher in TDN content as compared with the Dotted Fodder cowpea between the first and second cuts, respectively with significant differences (Table 33).

Combined analysis showed that Fodder cowpea types were of more TDN content than Bonavista bean types in their mixtures with pearl millet. The TDN content of pearl millet with any of the six Fodder legumes could be ranked in the following descending order: PM+ BrFC> PM-DFC > PM+BrB > PM+CFC > PM+WB > PM+BB type having a respective TDN content of 58.93, 58.69, 58.0, 57.87, 57.43 and 56.47 % with some significant differences in between as shown in Table (33).

It is recommended that mixtures of Pearl millet (PM) + Brown Fodder cowpea (BrFC) and Pearl millet (PM) - Dotted Fodder cowpea (DFC) were of the best mixture combinations regarding TDN content. The combined analysis (Table 33) indicated that TDN content of the proposed mixture was slightly increased during the first season as compared with the second one with significant differences.

Also, it is noticed that there was significant difference in TDN content for the earlier than the later cuts with different behaviour among the grown mixtures. The currently presented results of the behaviour of TDN content of Fodder crops and their mixtures

were more or less similar to those reported by **Sood and Sharma (1992)** in mixture of Sorghum with legumes, **Verma *et al.* (1997)** for Sudan grass with cowpea, **Chambliss and Ezenwa (2006)** for Pearl millet with lablab and **Armstrong and Albrecht (2008)** for maize with lablab

It is well noticed that mixtures of fodder cowpea and Bonavista bean types were of higher TDN content during the first cuts compared with the second ones.

It looks to be true that either Bonavista beans or Fodder cowpeas as a leguminous crops produced higher TDN content in the first than the second cuts in general.

So, it could be concluded that for any of the tested indigenous native forage legumes, their first cuts were of higher TDN content than the second cuts. This may clarify the similarity of the nature of vegetative growth for such types of legumes as affected by the prevailing environmental conditions which could be quite different during the earlier than the regrowth later stage of the growth.

For clear cut comparison the TDN content for mixtures with their relevant pure stand components assuming cropping in a similar land unit area could be presented as follows:

Mixtures product (%)	**Actual production in pure stands** (%)	**% of increase for each component of the related mixtures**
Actual production of mixtures (50:50%)	Pearl millet + legumes	PM + legumes
PM + BrFC (58.93)	58.30 + 55.14	1.0 + 5.7 %
PM + DFC (58.69)	58.30 + 57.59	0.7 - 1.9 %
PM + BrB (58.00)	58.30 + 57.94	0.5 - 0.1 %
PM + CFC (57.87)	58.30 - 57.04	0.7 + 1.5 %
PM - WB (57.43)	58.30 + 60.30	1.5 + 5.0 %
PM + BB (56.47)	58.30 - 57.92	3.2 - 2.6 %

The descending ranking order of the total digestible nutrient (TDN) content for the grown forage mixtures and their relevant pure stands in the following comparative set of data:

NO.	Treatments		TDN content (%)
1	White Bonavista bean	(BW)	60.30
2	Pearl millet + Brown Fodder cow pea	(PM + BRFC)	58.93
3	Pearl millet + Dotted Fodder cow pea	(PM + DFC)	58.69
4	Pearl millet	(PM)	58.30
5	Pearl millet + Brown Bonavista bean	(PM + BRB)	58.0
6	Brown Bonavista bean	(BRB)	57.94
7	Black Bonavista bean	(BB)	57.92
8	Pearl millet + Creamy Fodder cow pea	(PM + CFC)	57.87
9	Dotted Fodder cow pea	(DFC)	57.59
10	Pearl millet + White Bonavista bean	(PM + WB)	57.43
11	Creamy Fodder cow pea	(CFC)	57.04
12	Pearl millet + Black Bonavista bean	(PM + BB)	56.47
13	Brown Fodder cow pea	(BRFC)	55.14
	L.S.D at: 5 % for :		T= 0.98

B-Digestible protein (DP) content

Results in Table (34) present the digestible protein (DP) content of Bonavista bean types in their pure stands, the combined analysis clarified that the Brown and white B.bean types produced almost similar DP content which was 16.77 and 16.35 %, respectively without significant differences in between. Whereas, Black type was of the lowest significant DP content (12.30 %), which was of about 26.6 % lower in DP content as compared with each to the other two Bonavista bean types (White & Brown). In other words, Brown type of B.bean proved to be the best in DP content compared with Black type with significant differences.

Table (33): Total digestible nutrients (TDN) content of the studied forage legumes and pearl millet in their pure stands and relevant mixtures.

	Pure & Mixtures Forages*	First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
		......................(% on dry matter basis)......................								
Pure stands	PM	58.89	56.14	57.51	58.84	59.31	59.07	58.87	57.73	58.30
	WB	63.55	59.68	61.61	58.73	59.26	59.0	61.14	59.45	60.30
	BB	60.53	60.09	60.31	53.97	57.08	55.53	57.25	58.59	57.92
	BRB	57.26	55.66	56.46	61.27	57.55	59.41	59.27	56.60	57.94
	CFC	58.14	57.30	57.72	57.06	55.64	56.35	57.60	56.47	57.04
	BRFC	55.84	53.54	54.69	57.64	53.53	55.59	56.74	53.53	55.14
	DFC	62.36	57.14	59.75	55.87	54.99	55.43	59.11	56.06	57.59
Relevant mixtures (50 + 50 %)	PM + WB	59.16	58.16	58.66	55.65	56.76	56.21	57.40	57.46	57.43
	PM + BB	56.74	55.93	56.33	57.04	56.19	56.62	56.89	56.06	56.47
	PM + BRB	59.54	57.23	58.38	57.41	57.83	57.62	58.47	57.53	58.0
	PM + CFC	59.45	57.84	58.64	58.79	55.40	57.10	59.12	56.62	57.87
	PM+ BRFC	59.82	57.93	58.87	58.54	59.44	58.99	59.18	58.69	58.93
	PM + DFC	59.27	58.83	59.05	59.90	56.78	58.34	59.58	57.81	58.69
LSD at: 5% for:		F= 0.98	F= 1.16	F= 1.04	F= 1.64	F= 2.26	F= 1.74	F= 0.93, FY= 1.31	F= 1.23, FY= 1.75	F= 0.98, FY= 1.39

*** PM = Pearl millet, WB = White Bonavista bean, BB = Black Bonavista bean, BRB = Brown Bonavista bean, CFC= Creamy Fodder cow pea, BRFC = Brown Fodder cow pea, DFC = Dotted Fodder cow pea.**

Seasonal variations evidentiate significant difference in DP content among the tested Bonavista bean types. Data indicated that White type of Bonavista bean was significantly the highest in DP content compared to each of other two types (Brown and Black) during the first season. Meanwhile, Brown Bonavista bean type was significantly the highest in DP content compared to each of other two types (White and Black) during the second season (Table 34).

It is also clear that combined analysis proved that digestible protein (DP) content was generally higher in the first cuts than the second cuts for all of the tested Bonavista bean types with different significant magnitudes. The superiority in digestible protein

(DP) content of Brown B. bean type compared with the other two types was 29.6 % in the first cuts and 45% in the second cuts. Whereas, the differences between the Brown and White types were almost similar with no significant differences.

It is also noticed that all of the three tested B.bean types produced slightly higher DP content in the second season than the first season. This result could be due to the increase in temperature of the second season as compared with the previous season, as presented in Table (2-b).

In comparison, the DP content of pure fodder cowpea types, the combined analysis exerted significant differences within the three tested indigenous native F.cowpea types (Table 34).Whereas, similar trend was noticed for cowpeas type in their DP content among the seasonal variations, where the higher DP was noticed during the second season rather than the first season. The highest digestibility of protein (DP) which were noticed for all of the tested indigenous forage legumes for the second rather than the first season may be due to the relatively higher temperature during the second season compared with the first season (Table 2-b). Such relative higher temperature may enhance the physiological activities of plants which end up by producing more of light molecular-weight protein which used to be of hyper digestibility than the hyper molecular weight proteins.

Data in Table (34) of the combined analysis proved that all of the three types of Fodder cowpea exerted significant higher reduction in DP content during the second cuts as compared with the first ones with almost similar magnitudes. This result could be due to the reduction of growth behaviour. However, Bonavista bean types behaved in a similar trend as for Fodder cowpea types previously presented and discussed (Table 34).

In this respect, the overall comparisons between all of the tested six types of indigenous native legumes in their pure stands, the combined analysis indicated that each of the Brown and White types of Bonavista bean was higher in DP content as compared with any of the tested Fodder cowpea types (Table 34). These results confirm the more DP content of Bonavista bean types than F.cowpea types.

Brown type of B.bean was of more DP content type than the other two Bonavista bean types (White and Black type) with significant differences. However, Fodder cowpea types were of appreciable differences in their DP content. The respective DP content could be presented in the following descending order in Creamy cowpea, Dotted cowpea and Brown cowpea. Whereas, there was no appreciable differences between the later two types of Fodder cowpea in respect of DP contents.

Seasonal variations indicated more DP content in the second season than the first one, with slight ignorable differences as presented and discussed earlier.

It is generally noticed in pure stands that DP content was higher in the second season than the first one with significant differences. The descending ranking order of DP content was for: Brown Bonavista bean, White Bonavista bean, Creamy cowpea, Dotted cowpea, Brown cowpea then Black Bonavista bean. From such ranking order Brown B.bean type was the highest DP content during each of the two cuts, and Black Bonavista bean was of the lowest DP content during each of the two cuts. Whereas, there was about 29.6 %and 45 % higher in DP content as compared with the Black Bonavista bean during each of the two subsequent cuts respectively with significant differences (Table 34).

It is also noticed from the combined analysis that Fodder cowpea types have more DP content than Bonavista bean types in their mixtures with pearl millet. In mixtures DP content of pearl millet with any of the six Fodder legumes could be ranked in the following descending order: PM+DFC > PM+BrFC > PM+CFC > PM+BrB > PM+WB > PM+BB type having a respective DP content of 8.11, 8.03, 7.84, 6.73, 6.08 and 5.76 % with some significant differences in between as shown in Table (34).

It could be recommended that mixtures Pearl millet (PM) + Dotted Fodder cowpea (DFC) and Pearl millet (PM) + Brown Fodder cowpea (BrFC) were of the highest combinations regarding DP content.

From the combined analysis (Table 34) digestible protein (DP) content of the proposed mixture was of more increase during the second season compared with the first one

with significant differences. So, it is also clear that mixtures were quite successful in growth when the ambient temperature of the summer season increased (Table 2-b).

Also, it is noticed that there was significant difference in digestible protein (DP) content for the earlier than the later cuts with different behaviour among the grown mixtures. This result is appreciably accepted since the first cuts may different than the later cuts.

It is well noticed that the mixtures of fodder cowpea and B. bean types with pearl millet were of higher DP content during the first cuts compared with the second ones. This is due to either Bonavista bean or Fodder cowpea types as a herbaceous leguminous crops produced higher DP content in the first than the second cuts in general.

The descending ranking order of the digestible protein (DP) for the grown forage mixtures and their relevant pure stands in the following comparative set of data:

NO.	Treatments		Digestible protein content (%)
1	Brown Bonavista bean	(BRB)	16.77
2	White Bonavista bean	(WB)	16.35
3	Creamy Fodder cow pea	(CFC)	16.04
4	Dotted Fodder cow pea	(DFC)	14.67
5	Brown Fodder cow pea	(BRFC)	14.21
6	Black Bonavista bean	(BB)	12.30
7	Pearl millet + Dotted Fodder cow pea	(PM + DFC)	8.11
8	Pearl millet + Brown Fodder cow pea	(PM + BRFC)	8.03
9	Pearl millet + Creamy Fodder cow pea	(PM +CFC)	7.84
10	Pearl millet + Brown Bonavista bean	(PM + BRB)	6.73
11	Pearl millet + White Bonavista bean	(PM + WB)	6.08
12	Pearl millet	(PM)	5.84
13	Pearl millet + Black Bonavista bean	(PM + BB)	5.76
	L.S.D at: 5 % for :		T= 1.23

In comparing DP content for mixtures with their relevant pure stand in a similar land unit area could be presented as follow in a descending order:

Mixtures product (%)	Actual production in pure stands (%)	% of increase for each component of the related mixtures
Actual production of mixtures (50:50%)	Pearl millet + legumes	PM + legumes
PM + DFC (8.11)	5.84 + 14.67	38.9 + 80.9 %
PM + BrFC (8.03)	5.84 + 14.21	37.5 + 77 %
PM + CFC (7.84)	5.84 + 16.04	34.2 + 104.6 %
PM + BrB (6.73)	5.84 + 16.77	15.2 + 149.1%
PM + WB (6.08)	5.84 + 16.35	4.1 + 168.9 %
PM + BB (5.76)	5.84 + 12.30	1.39 + 113.5 %

Table (34): Digestible protein (DP) content of the studied forage legumes and pearl millet in their pure stands and relevant mixtures.

Pure & Mixtures Forages*		First summer season (2007)			Second summer season (2008)			Combined (over growing seasons)		
		1st cut	2nd cut	Mean	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
		........................(% on dry matter basis)........................								
Pure stands	PM	6.15	*3.80*	4.97	6.92	6.48	6.70	6.54	*5.14*	5.84
	WB	16.14	14.46	15.30	19.14	15.65	17.40	17.64	15.05	16.35
	BB	14.87	12.18	13.52	12.59	9.54	11.06	13.73	10.86	12.30
	BRB	14.92	13.54	14.23	20.67	17.93	19.30	17.80	15.74	16.77
	CFC	15.84	13.54	14.69	18.70	16.08	17.39	17.27	14.81	16.04
	BRFC	13.54	11.23	12.38	17.18	14.88	16.03	15.36	13.05	14.21
	DFC	15.38	13.08	14.23	16.41	13.80	15.12	15.90	13.44	14.67
Relevant mixtures (50 + 50 %)	PM +WB	6.61	4.30	5.45	7.69	5.72	6.71	7.15	5.01	6.08
	PM + BB	4.30	3.38	3.84	7.69	7.69	7.69	5.99	5.53	5.76
	PM + BRB	6.61	6.15	6.38	8.77	5.40	10.93	7.69	5.77	6.73
	PM + CFC	8.46	5.22	6.84	9.21	8.46	8.64	8.83	6.84	7.84
	PM+ BRFC	6.61	5.22	5.91	11.82	8.46	10.14	9.22	6.84	8.03
	PM + DFC	7.53	6.61	7.07	9.54	8.77	9.15	8.53	7.69	8.11
LSD at: 5% for:		F= 1.22	F= 1.21	F= 1.22	F= 2.21	F= 2.21	F= 2.21	F= 1.23, FY= 1.73	F= 1.23, FY= 1.73	F= 1.23, FY= 1.73

* PM = Pearl millet, WB = White Bonavista bean, BB = Black Bonavista bean, BRB = Brown Bonavista bean, CFC= Creamy Fodder cow pea, BRFC = Brown Fodder cow pea, DFC = Dotted Fodder cow pea.

5. SUMMARY

Six field experiments were carried out at the Experimental Research Center, Faculty of Agriculture, Moshtohor, Benha University, Kalubia Governorate during two growing seasons (2007 and 2008) in three different studies.

I. The first study

Bonavista bean performance

Experiments were designed and implemented to evaluate fresh and dry forage yield, vegetative growth behaviour, and quality determinations of three Egyptian indigenous-native forage legumes (Bonavista bean White seed-coat, Black seed-coat and Brown seed-coat) planted in 3 population densities with three seeding rates in respect of (10, 20 and 30 kg/fed).

Experiments were layed out and statistically analyzed as split plot design where Bonavista bean types were randomly distributed in the main plots and seeding rates in the split plots. Two individual cuts were obtained in each of the two growing seasons and their combined analysis. Results could be summarized as follows:

- Fresh forage yield

-Results of the combined analysis indicated significant differences in total fresh forage yield among the studied Bonavista bean types. The White type was of the highest significant total fresh forage production (22.25 ton/fed), whereas, Brown and Black Bonavista bean type produced almost similar fresh forage yield which was 19.03 and 19.06 ton /fed, respectively. So, the White type of B.bean was of about 17% higher in fresh forage yield as compared with the other two types (Brown and Black).

-The combined analysis clarified that total forage yield of each of the grown Bonavista bean types substantially increased as seeding rates increased with significant differences of various magnitudes. As seeding rates increased from 10 to 20 and up to 30 kg /fed, total fresh forage yield was increased with a respective production of 17.49, 20.38 and 22.47 ton/fed.

-Results generally indicated that the highest fresh forage yield was obtained from White B. bean types when planted at the highest seeding rates (30kg/fed). Meanwhile, the lowest forage yield was obtained from Brown Bonavista bean type, planted at the lowest seeding rate (10kg/fed), where the interaction effect between types and seeding rates was significant.

- Dry forage yield

-Total dry forage yield productivity could be ranked in the following descending order: White > Black> Brown Bonavista bean types. The respective total dry forage yield was 3.62, 3.04 and 1.03 ton/fed. It should be clarified that highest productive dry forage was recorded for the White Bonavista bean type, whereas, the lowest one was for the Brown type. The White type was of about 28% higher in dry forage yield as compared with the other two types (Black and Brown).

-Regarding the impact of seeding rates, combined analysis(over the grown types) indicated that the obtained total dry yield of each of the grown Bonavista bean types substantially increased as seeding rates increased significantly. As seeding rates increased from 10 to 20 and up to 30 kg /fed, total dry yield was significantly increased with a respective production of 2.81, 3.25 and 3.47 ton /fed.

-Results evidentiate that highest dry forage yield was obtained for White type when planted at the highest seeding rate (30kg /fed). Meanwhile, the lowest dry yield was obtained from the Black Bonavista bean type, planted at the lowest seeding rate (10kg/fed.).

Vegetative growth characteristics

-Plant height

-Combined analysis clarified appreciable significant differences in plant height among the studied Bonavista bean types with variable significant magnitudes. Plant height could be ranked in the following descending order: Black then White followed by Brown Bonavista bean types. The respective plant heights were 165.15, 109.87 and 91.03 cm. In should be clarified that highest plant height was recorded for the Black

Bonavista bean type, whereas, the lowest one was for the Brown type. The Black type was of about 81.4% taller in plant height as compared with the other two types (White and Brown).

-The combined analysis indicated that the obtained plant heights of each of the grown Bonavista bean types substantially decreased as seeding rates increased significantly. As seeding rates increased from 10 to 20 and up to 30 kg /fed, plant heights was significantly decreased with a respective plant heights of 140.44, 122.70 and 102.91 cm.

-Results proved that tallest plant were obtained for Black type when planted at the lower seeding rates (10kg/fed). Meanwhile, shortest plant heights were obtained from Brown type, planted at the highest seeding rate (30kg/fed).

-Stem diameter

-The Black and the Brown Bonavista bean types were of similar stem diameter which was 0.91cm. Meanwhile, the White type was of the thinnest stem diameter (0.81 cm). Brown and Black types were of about 12.3 % thicker in stem diameter as compared with the White type of Bonavista bean.

-The combined analysis (over the grown Bonavista bean types), indicated that the obtained stem diameter of each of the grown types decreased as seeding rates increased significantly. As seeding rates increased from 10 to 20 and up to 30 kg /fed, stem diameter was significantly decreased with a respective stem diameter of 1.09, 0.86 and 0.67 cm.

-Results evidentiated that largest stem diameters were obtained for Black type when planted at the lightest seeding rates (10kg/fed). Meanwhile, the lowest stem diameter was obtained from Black type planted at the highest seeding rate (30kg/fed).

-Leaf area / plant

-The combined analysis (over the applied seeding rates), exerted no significant differences in leaf area /plant among the studied Bonavista bean types. However, leaf area /plant could be ranked in the following descending order: Brown (923.74cm^2)

then White (911.92cm^2) followed by Black (857.96cm^2) without significant differences. In this respect, the highest leaf area /plant was produced for the Brown type, which was of about 7.7 % higher in leaf area /plant as compared with the other two types (Black and White).

-The combined analysis (over the grown types), clarified that the obtained leaf area / plant of each of the grown types substantially decreased as seeding rates increased significantly. As seeding rates increased from 10 to 20 and up to 30 kg /fed, leaf area was significantly decreased with a respective area per plant of 1232.93, 870.03 and 590.67 cm^2 / plant. Whereas, the lowest seeding rate (10 kg/fed) was of about 42% and 109% higher in leaf area / plant as compared with the medium (20 kg/fed) and highest seeding rate (30 kg /fed.). Meanwhile, the medium seeding rate was of about 47% higher in leaf area as compared with the highest seeding rates with appreciable significant differences.

-Data evidentiated that highest leaf area /plant was obtained for White type when planted at the lowest seeding rates (10kg/fed). Whereas, the lowest leaf area / plant was obtained from Black type, planted at the highest seeding rate (30kg/fed).

-Leaf / stem ratio

-Leaf /stem ratio could be ranked in the following descending order: Brown (0.84) then White (0.81) followed by Black type (0.67).It was noticed that the highest leaf /stem ratio was recorded for the Brown type. Whereas, the lowest one was for the Black type. The Brown type was of about 25 % higher in leaf /stem ratio as compared with the other two types of Bonavista bean (Black and White).

-Combined analysis showed no significant differences in leaf /stem ratio of plants at the applied seeding rates (Table 8). The obtained leaf /stem ratio of plants for each of the grown types substantially decreased as seeding rates increased with no significant differences. As seeding rates increased from 10 to 20 and up to 30 kg /fed, leaf /stem ratio of plants was decreased with a respective ratios of 0.97, 0.78 and 0.75.

-Results clarified that highest leaf / stem ratio was obtained for plants of Brown type when planted at the medium seeding rates (20kg/fed). Meanwhile, the lowest leaf / stem ratio was obtained for plants of Black type, planted at the highest seeding rate (30kg/fed).

-Light intensity effect

-Among the studied Bonavista bean types; Light intensity differences (from the atmost top of plants and close to the soil surface) could be ranked in the following descending order: White (83291lux) then Black (82181lux) followed by Brown (81279lux).Whereas, the White type was of about 2.5 % higher in light intensity differences as compared with the other two types (Black and Brown type).

-The obtained light intensity difference for each of the grown types substantially increased as seeding rates increased significantly. In other words, as seeding rates increased from 10 to 20 and up to 30 kg /fed, light intensity difference was significantly increased with a respective light intensity difference of 79587.02, 82205.90 and 84963.83 lux. Whereas, the highest seeding rate was of about 7 % higher in light intensity difference as compared with the other two seeding rates (10 and 20 kg /fed.).

-Results evidentiated that highest light intensity difference was obtained for White type when planted at the highest seeding rates (30kg/fed). Meanwhile, the lowest light intensity difference obtained from the Brown type, planted at the lowest seeding rate (10kg/fed).

-Number of shoots/m^2

-Combined analysis (over the applied seeding rates) clarified no significant differences in number of shoots among the studied Bonavista bean types. However, number of shoots/m2 could be ranked in the following descending order: White (19.8) then Brown (18.3) followed by Black (14.8 shoots/m2) without significant differences.

-The combined analysis (over the grown Bonavista bean types), indicated that the obtained number of shoots /m2of each of the grown types increased as seeding rates

increased with significant differences. As seeding rates increased from 10 to 20 and up to 30 kg /fed. number of shoots /m2 was significantly increased with a respective number of shoots /m2 of 10.8, 16.8 and 25.4 shoots/m2. Whereas, the highest seeding rate was of about 135 % higher in number of shoots/m2 as compared with the other two seeding rat (10 and 20 kg /fed.).

-Results evidentiate that highest number of shoots /m^2 was obtained for White type when planted at the highest seeding rates (30kg/fed). Whereas, the lowest number of shoots /m^2 was obtained for Black type, planted at the lowest seeding rate (10kg/fed) where the interaction was significant.

-Chemical constituents

-Crude protein (CP) content

-The descending ranking order for CP content was 20.93, 19.93 and 19.19% for Brown (Br), Black (B) and White (W) Bonavista bean types in leaves being 9.52, 8.53 and 7.86% in stems of white, Brown and Black Bonavista bean.

-Over the grown types of Bonavista bean, combined analysis revealed significant decrease in CP content of their leaves and stems by the increase seeding rates from 10 to 20 and up to 30kg/fed. having respective CP content of 22.16, 20.23 and 17.68% in leaves, being 9.27, 8.66 and 7.99%in stems.

-Results indicated significant interaction effect for Bonavista bean types and plant population densities on CP content of leaves and stems, where the Black type planted at the lowest seeding rates (10 kg/fed) produced the highest leaf-CP content (25.79%) of the first cut, whereas, the same type produced the lowest CP content (12.97%), planted at seeding rates of 30 kg/fed. for the second cut. Almost similar trend was noticed for stems with similar magnitudes, where the White type produced the highest stem-CP content (11.74%) of the first cut, planted at the lowest seeding rates (10 kg/fed). Meanwhile, Black type produced the lowest stem-CP content (6.57%) of the second cut, planted at the highest seeding rates (30 kg/fed).

-Crude fiber (CF) content

-Regarding stems-CF content, slight ignorable differences was noticed where Brown type was higher than White type which in turn was higher than Black type this trend was noticed during the first season and the second cuts with very slight ignorable differences.

-As seeding rates increased from 10 to 20 up to 30 kg/fed CF content was substantially increased respectively, being 22.23, 24.65 and 26.84%. This trend was repeated for each of the two growing season and for each cut with significant difference either in leaves or stems with relatively higher magnitudes for stems rather than leaves and for the second than the first season.

-Results indicated significant interaction effect of Bonavista bean types and plant population densities on CF content of leaves and stems, where the Brown type planted at the highest seeding rates (30 kg/fed) produced the highest leaf-CF content (27.17%) of the second cut, whereas, the same type produced the lowest CF content (20.12%), planted at the lowest seeding rates (10 kg/fed.) for the first cut. Almost similar trend was noticed for stems with similar magnitudes, whereas, the White type produced the highest stem-CF content (47.0%) of the second cut, planted at the highest seeding rates (30 kg/fed). Meanwhile, Brown type produced the lowest stem-CF content (36.54%) of the first cut, planted at the lowest seeding rates (10 kg/fed).

-Ash content

-Ash-contents of leaves and stems for Bonavista bean types were significant different with slight variable magnitudes. The descending respective leaves-ash values were for Black (14.58%), White (13.67%) and Brown (13.58%), whereas, the respective stems-ash contents were for Brown (11.42%), White (10.83%) and Black type (9.83%).

-Over Bonavista bean types, increasing seeding rates caused very slightly reduction in stem-ash contents within quite ignorable levels.

-Results indicated significant interaction effect of Bonavista bean types and plant population densities on ash content of leaves and stems, where the Black type planted

at the highest seeding rates produced the highest leaf-ash content of the second cut, whereas, the White type produced the lowest ash content, planted at highest seeding rates for the second cut. Almost similar trend was noticed for stems with similar magnitudes, where the Brown type produced the highest stem-ash content of the first cut, planted at the lowest seeding rates Meanwhile, Black type produced the lowest stem-ash content of the first cut, planted at the lowest seeding rates.

-Ether extract (EE) content

-The range of EE is very narrow and does not exceed appreciable value for response for any of the investigated factors under study or on its impact on EE for either leaves or stems for any of the studied Bonavista bean types.

-Nitrogen free extract (NFE) content

-Bonavista bean types varied significantly in their leaf and stem-NFE content. Results indicated the highest and lowest NFE values for leaves-NFE were noticed for White (W) and Black (B) types of Bonavista bean, respectively. Leaf-NFE contents were 37.96, 36.52 and 35.74% for White, Brown and Black respectively. Whereas for stems-NFE contents it was 39.44, 35.71 and 35.57% NFE for Black, Brown and White, respectively.

-Seeding rate did not follow specific trend in its effect on the NFE content of leaves. Whereas, stem-NFE contents were decreased as seeding rate increased significantly (Tables, 19&20). This trend was not noticed during seasons and their cuts with significant differences.

-Results indicated significant interaction effect of Bonavista bean types and plant population densities on NFE content of leaves and stems, where the White type planted at the highest seeding rates produced the highest leaf-NFE content of the second cut, whereas, the Brown type produced the lowest NFE content, planted at the highest seeding rates for the first cut. Almost similar trend was noticed for stems with similar magnitudes, where the Black type produced the highest stem-NFE content of

the second cut, planted at the lowest seeding rates Meanwhile, White type produced the lowest stem-NFE content of the second cut, planted at the highest seeding rates.

-Nutritive value

A-Total digestible nutrients (TDN) content

-Combined analysis indicated that the Brown Bonavista bean type was significantly higher in the TDN as compared with the other two types (White and Black types).

-The TDN of leaves and stems of Bonavista bean type were decreased as seeding rates increased from 10 to 20 and up to 30kg/fed respectively. The respective TDN values were 65.96, 63.52 and 61.02% for leaves, being 49.59, 47.59 and 45.15% for stems.

-Results indicated significant interaction effect of Bonavista bean types and plant population densities on TDN content of leaves and stems, where the Brown type planted at the lowest seeding rates produced the highest leaf-TDN content of the first cut, whereas, the Brown type produced the lowest TDN content, planted at the highest seeding rates for the second cut. Almost similar trend was noticed for stems with similar magnitudes, where the Brown type produced the highest stem-TDN content of the first cut, planted at the lowest seeding rates Meanwhile, White type produced the lowest stem-TDN content of the second cut, planted at the highest seeding rates.

B-Digestible protein (DP) content

-Results showed parallel behaviors trend of almost similar trend to CP content previously presented.

II-The second study

Fodder cowpea performance

Experiments were designed and implemented to evaluate fresh and dry forage yield, vegetative growth behaviour, and quality determinations of three Egyptian indigenous-native forage legumes (Fodder cowpea types: Creamy seed-coat, Brown seed-coat and Dotted seed-coat) planted with three seeding rates in respect of population densities (15, 30 and 45 kg/fed).

Experiments were layed out and statistically analyzed as split plot design where Bonavista bean types were randomly distributed in the main plots and seeding rates in the split plots. Two individual cuts were obtained in each of the two growing seasons and their combined analysis. Results could be summarized as follows:

-Fresh forage yield

-Results of the combined analysis indicated significant differences among the studied fresh fodder cowpea types. The Creamy type was of the highest forage production (19.88 ton / fed). However, Brown and Dotted types produced almost similar forage yield which was 19.88 and 19.49 ton / fed., respectively. Whereas, Brown type was of the lowest significant fresh forage production (18.17 ton / fed), which was of about 9% lower in forage yield as compared with each to the other two types.

-The combined analysis clarified that total fresh forage yield of each of the grown types substantially increased as seeding rates increased with significant differences of various magnitudes. Total forage yield was of significant increase with a respective production of 17.67, 19.17 and 20.70 ton / fed. as seeding rates increased from 15 to 30 and up to 45 kg/fed.

-Results generally indicated that the highest forage yield was obtained for Creamy type when planted at the highest seeding rate (45 kg / fed). Meanwhile, the lowest fresh forage yield was obtained from Brown type, planted at the lowest seeding rate (15kg/ fed) with significant interaction differences.

- Dry forage yield

-Dotted and Creamy fodder cowpea types produced almost similar dry forage yield which was 2.85 and 2.83 ton/fed, respectively. Whereas, Brown type was of slightly lowest dry forage production (2.68 ton/fed), Moreover, the Dotted type was of about 6% higher in dry matter yield as compared with the other two types (Creamy and Brown). These results were not the same in fresh forage yield previously presented and discussed.

-The combined analysis revealed that total dry matter yield of each of the grown types substantially increased as seeding rates increased with significant differences of various magnitudes. As seeding rates increased from 15 to 30 and up to 45 kg/fed. Total dry matter yield was substantially increased with significant differences. The respective increase in dry yield production was 2.57, 2.74 and 3.05 ton/fed.

-Results showed that the highest dry forage yield was obtained for the Dotted type when planted at the highest seeding rates (45 kg/fed). Meanwhile, lowest dry forage yield was obtained from Brown type planted at the thinnest plant population densities (15 kg/fed) with significant interaction differences.

Vegetative growth characteristics

-Plant height

-Creamy fodder cowpea type was of the tallest plants (79.87cm). Whereas, the Brown and Dotted fodder cowpea produced almost similar plant heights which were 75.88 and 74.92 cm, respectively. Moreover, Creamy type was of about 6.6 % taller in plant heights as compared with the other two types (Dotted and Brown).

-Combined analysis (Over the grown types) revealed that plant height of each of the grown fodder cowpea types decreased as seeding rates increased with significant differences of various magnitudes. As seeding rates increased from 15 to 30 and up to 45 kg/fed. Plant heights were substantially decreased with significant differences with respective heights of 80.88, 77.27 and 72.52 cm.

-Results generally indicate that tallest plant heights were obtained for Creamy fodder cowpea type when planted at the lowest seeding rate (15 kg / fed). Meanwhile, the shortest plant heights were obtained from Dotted fodder cowpea, planted at the heaviest seeding rate (45kg/ fed).

-Stem diameter

-Combined analysis showed no significant differences in stem diameters between the studied fodder cowpea types.

-Over the grown fodder cowpea types indicated that the obtained stem diameter of each of the grown fodder cowpea types continuously decreased as seeding rates increased significantly. As seeding rates increased from 15 to 30 and up to 45 kg/fed. Stem diameters were decreased with a respective stem diameter of 0.67, 0.57 and 0.52 cm.

-Results generally showed that the highest stem diameters were obtained for Creamy fodder cowpea type when planted at the lowest seeding rate (15 kg / fed). And the lowest stem diameters were obtained also from Creamy fodder cowpea, planted at the highest seeding rate (45kg/ fed) with significant interaction.

-Leaf area / plant

-Creamy fodder cowpea type was of the highest leaf area /plant ($274.12cm^2$) then Brown type ($254.44cm^2$) followed by Dotted type ($243.05cm^2$). In this respect, Creamy fodder cowpea type was of about 13% higher in leaf area /plant as compared with the other two types (Brown and Dotted).

-Combined analysis (over the grown types) clarified that the obtained leaf area /plant over grown types gradually decreased as seeding rates increased significantly. As seeding rates increased from 15 to 30 and up to 45 kg/fed., leaf area / plant was respectively decreased (354.85, 243.03 and 173.73 cm^2/plant). The lowest seeding rate (15 kg/ fed.) produced plants of 104 % higher in leaf area / plant as compared with the higher seeding rates (30.and 45 kg /fed.).

-Results generally showed that the highest leaf area /plant was obtained for Creamy fodder cowpea type when planted at the lowest seeding rate (15 kg / fed). Meanwhile, the lowest leaf area / plant was obtained for Dotted fodder cowpea, planted at the highest seeding rate (45kg/fed), where the interaction were significant.

-Leaf / stem ratio

-The Brown fodder cowpea type was of the highest leaf / stem ratio (0.74). Whereas, the Creamy and Dotted fodder cowpea types recorded almost similar leaf / stem ratio which were 0.67 and 0.65 respectively. Moreover, the Brown type plants was of about

14 % higher in leaf / stem ratio as compared with the other two types of fodder cowpea (Creamy and Dotted).In this respect, the Creamy fodder cowpea type was of about 13 % higher in leaf area /plant as compared with the other two types (Brown and Dotted).

-The combined analysis (Over the grown fodder legumes) revealed that the obtained leaf / stem ratio of plants over grown fodder cowpea types substantially decreased as seeding rates increased with no significant differences. As seeding rates increased from 15 to 30 and up to 45 kg/fed. Leaf /stem ratio of plants was slightly and substantially decreased without significant differences of 0.72, 0.67 and 0.67, respectively.

-Results clarified that the highest leaf / stem ratio of plants was noticed for Brown fodder cowpea type when planted at the highest seeding rate (45 kg / fed). Meanwhile, the lowest leaf /stem ratio was obtained from Dotted fodder cowpea, planted at the highest seeding rate (45kg/fed).

-Light intensity effect

-Results from the combined analysis (over the applied seeding rates), clarified significant differences in light intensity difference between the studied Fodder cowpea types. However, the Brown type was of the highest light intensity difference (80882.94lux) then Creamy type (79267.19lux) followed by Dotted type (78929.67lux).

-Combined analysis(over the grown types) revealed that the obtained light intensity difference of each of the grown types increased as seeding rates increased significantly. As seeding rates increased from 15 to 30 and up to 45 kg/fed. Light intensity difference was increased with a respective 75831.88, 80663.17 and 82584.75lux. Whereas, the highest seeding rate was of about 9 % higher in light intensity difference as compared with the other two seeding rates (15.and 30kg /fed.).

-Results generally showed that the highest light intensity difference was obtained for the Brown type when planted at the highest seeding rate (45kg/fed). Meanwhile, the

lowest light intensity difference was obtained from Dotted type, planted at the lowest seeding rate (15 kg/fed) with significant interaction differences.

- Number of shoots/m^2

-Results from the combined analysis (over seeding rates), indicated significant differences in number of shoots /m^2 between the studied fodder cowpea types. However, the Creamy type was of the highest number of shoots /m^2 (91.7) then Dotted type (87.7) followed by Brown type (83.8 shoots/m^2). Number of shoots/m^2 could be ranked in the following descending order: Creamy, Dotted and Brown types produced 107.2, 91.4 and 87.4 shoots/m^2, respectively with significant differences in the first season and with insignificant differences order for the second season.

-Combined analysis (over the grown types) revealed that the obtained number of shoots /m^2 over the grown types increased as seeding rates increased significantly. As seeding rates increased from 15 to 30 and up to 45 kg/fed., number of shoots/m^2 was substantially increased with a respective 53.3, 91.4 and 118.3 shoots/m^2. Whereas, the highest seeding rate was of about 122 % higher in number of shoots /m^2 as compared with the other two seeding rates (15 and 30kg /fed.).

-Results generally showed that the highest number of shoots/m^2 was obtained for the Brown type when planted at the highest seeding rate (45kg/fed). Meanwhile, the lowest number of shoots/ m^2 was obtained from Brown type when planted at the lowest seeding rates (15kg/fed).

-Chemical constituents

-Crude protein (CP) content

-Leaf-CP content was in the following descending order: Dotted (21.91%), Brown (20. 98%), then Creamy (20.14%) with significant differences, whereas, no significant differences were noticed in stems-CP contents.

-Increasing seeding rates from 15 to 30 and up to 45kg/fed caused substantial decrease in Leaf-CP content from 23.03 to 21.23 and down to 18.77%, being 10.13, 8.96 and 8.07% for stem-CP content.

-Results indicated significant interaction effect of Fodder cowpea types and plant population densities on CP content of leaves and stems, where the Dotted type planted at the lowest seeding rates (15 kg/fed) produced the highest leaf-CP content (25.26%) for the first cut, whereas, the same type produced the lowest CP content (16.76%), planted at highest seeding rates (45kg/fed.) for the second cut. Almost similar trend was noticed for stems with similar magnitudes, where the Creamy type produced the highest stem-CP content (11.23%) of the first cut, planted at the lowest seeding rates (15 kg/fed whereas, the same type produced the lowest CP content (7.0%), planted at highest seeding rates (45kg/fed.) for the second cut.

-Crude fiber (CF) content

-Creamy Fodder cowpea type was of the highest Leaf-CF content (28.15%), lower in Dotted type (27.73%) and the least in Brown type (25.71) with significant differences. Similar trend was noticed in the first season and the first cuts.

-Results showed that as plant population densities per fed. of Fodder cowpea types by increasing seeding rates from 15 to 30 and up to 45kg/fed, there was a respective continuous slight significant increase in Leaves & stems-CF to be 25.07, 26.83, 29.69% for leaves being 33.83, 40.35, 44.33% in stems.

-Results indicated significant interaction effect of Fodder cowpea types and plant population densities on CF content of leaves and stems, where the Dotted type planted at the highest seeding rates (45 kg/fed) produced the highest leaf-CF content (31.37%) of the second cut, whereas, the Brown type produced the lowest CF content (22.29%), planted at the lowest seeding rates (15kg/fed.) for the first cut. Almost similar trend was noticed for stems with similar magnitudes, where the Brown type produced the highest stem-CF content (46.33%) of the second cut, planted at the highest seeding

rates (45 kg/fed). Whereas, Creamy type was of the lowest CF content (34.75%), planted at seeding rates of 15kg/fed. for the first cut.

-Ash content

-Leaves-ash contents for Fodder cowpea types was 13.33, 13.24 and 13.00% for Dotted type, Creamy type and Brown type respectively, being 11.50, 11.28 and 10.92% for the respective Brown, Dotted and Creamy types for their stem-ash content. It is also noticed the obtain leaf or ash-contents were fluctuated of no specific trend among seasons and cuts.

-Ash contents for either leaves or stems were more or less of narrow ranges without identified trend since the obtained values were fluctuated within ignorable ranges in most cases.

-Results indicated significant interaction effect of Fodder cowpea types and plant population densities on ash content of leaves and stems, where the Dotted type planted at the highest seeding rates produced the highest leaf-ash content (14.25%) of the second cut, whereas, the Creamy type produced the lowest ash content (12.42%), planted at the highest seeding rates for the second cut. Almost similar trend was noticed for stems with similar magnitudes, where the Brown type produced the highest stem-ash content (12.17%) of the second cut, planted at the medium seeding rates. Whereas, Creamy type produced the lowest ash content (10.0%), planted at the highest seeding rates for the first cut.

- Ether extract (EE) content

-The range of EE is very narrow and does not exceed appreciable value for response for any of the investigated factors under study or on its impact on EE for either leaves or stems for any of the studied Fodder cowpea types.

- Nitrogen free extract (NFE) content

-Fodder cowpea types were of significant differences in their leaf-NFE contents. Whereas, Brown types of the highest leaf-NFE. While, Creamy and Dotted types were

of similar NFE contents. Such trend was noticed during the two growing seasons, but not during the cuts. However, the Creamy type was of the highest stem-NFE contents significantly, while, Dotted and Brown types were or almost similar in stem-NFE content. Such trend was recorded during the second season and the two cuts.

-Seeding rates did not show wide (33.26 -32.82%) significant differences in their Leaf-NFE contents, whereas, stems-NFE showed slight significance decrease as seeding rates increased from 15 to 30 up to 45kg/fed. where the respective Leaf-NEF was 37.87, 36.73 and 34.77%. such slight significant decrease in Leaf-NEF was noticed during the first and second growing seasons and for each of the obtained cuts. Whereas, in the second cuts differences did not reach the level of significant level.

-Results indicated significant interaction effect of Fodder cowpea types and plant population densities on ash content of leaves and stems, where the Creamy type planted at the highest seeding rates produced the highest leaf-NFE content for the first cut, whereas, the Brown type produced the lowest NFE content, planted at the lowest seeding rates for the second cut. Almost similar trend was noticed for stems with similar magnitudes, where the Creamy type produced the highest stem-NFE content of the first cut, planted at the medium seeding rates. Whereas, Brown type produced the lowest NFE content, planted at the highest seeding rates for the second cuts.

- Nutritive value

A-Total digestible nutrients (TDN) content

-Combined analysis showed that the Brown cowpea types have the highest TDN content in leaves (63.00%) and the lowest level in stems (47.06%). An opposite trend was noticed for Creamy type which have the highest level in stems (49.38%) and the lowest values of TDN in leaves (60.93%).

-The TDN of plants increased by increasing seeding rates of Fodder cowpea from 15 to 30 and up to 45 kg/fed, where the obtained TDN substantially decreased with significant differences.

-Results indicated significant interaction effect of Fodder cowpea types and plant population densities on TDN content of leaves and stems, where the Dotted type planted at the lowest seeding rates produced the highest leaf-TDN content of the first cut, whereas, the same type produced the lowest TDN content, planted at the highest seeding rates for the second cut. Almost similar trend was noticed for stems with similar magnitudes, where the Creamy type produced the highest stem-TDN content of the first cut, planted at the lowest seeding rates. Also, Brown type produced the lowest TDN content, planted at the highest seeding rates for the second cut.

- B-Digestible protein (DP) content

-Results showed more or less similar behaviour to CP content previously presented.

III-The third complementary study

Mixing the studied forage legumes with pearl millet

The target of this investigation is to study the potentiality response for each of the studied forage legumes (3 Bonavista bean types and 3 Fodder cowpea types) and pearl millet as a favorite fodder grass in their pure stands and relevant mixtures. Experiment included 13 treatments in 4 replications.

The ultimate target of these investigations is to introduce, evaluate and select among the best fit native indigenous legumes when mixed with pearl millet to enhance the interrelated benefits and advantages of the biological biodiversities of such mixtures, regarding forage behaviour and characteristics in respect of production and quality.

For this complementary study, investigations were devoted to compare the production and nutritive value of each of the studied six herbaceous forage legumes (3 Bonavista bean types and 3 Fodder cowpea types) in their monoculture as well as their potentialities if mixed with pearl millet as super selected fodder grass in 50:50 % ratio. Such study was designed to find out the added values of mixing legumes and grasses on forage yield and quality of the tested native indigenous legumes in the first and second study.

The experimental design was layed out in a complete randomized block design type with four replicates in each of the two seasons. The pure and mixtures forages

(previously mentioned) were distributed randomly in plots. Two individual cuts were obtained in each of the two growing seasons and their combined analysis. Results could be summarized as follows:

- Fresh forage yield

-White type of Bonavista bean was of significant superior production (20.45 ton/fed.) as compared with the other types under study, Whereas, the Brown and Black types produced almost similar fresh forage yield which was 17.85 and 17.45 ton/fed, respectively with significant increase of about 17 % than the other two types.

-Total forage yield from the combined analysis did not show significant differences within the three tested indigenous native F. Cowpea types in their pure stands.

-The combined analysis revealed that each of the 3 types of Bonavista bean was higher in total fresh forage yield as compared with any of Fodder cowpea types.

-It is recommended that either of the two mixtures Pearl millet (PM) + Brown Bonavista bean (BrB) and Pearl millet (PM) + White Bonavista bean (WB) were the best favorable combinations in total fresh forage biomass.

- Dry forage yield

-In pure stands, White type of Bonavista bean was of the highest significant dry forage production (3.01 ton/fed), whereas, Black and Brown Bonavista bean produced almost similar dry forage yield which was 2.70 and 2.55 ton /fed, respectively. So, the White type was of about 18% higher in dry forage yield as compared with the other two types (Black and Brown).

-Total dry yield (from the combined analysis) exerted significant differences within the three tested indigenous native fodder cowpea types in their pure stands.

-The overall comparisons in pure stands for all of the tested six types of indigenous native legumes, the combined analysis clarified that each of the White and Black types was higher in total dry yield as compared with any of the tested fodder cowpea types.

-It is recommended that mixtures Pearl millet (PM) + White Bonavista bean (WB) and Pearl millet (PM) + Brown Bonavista bean (BrB) were the best combinations regarding dry forage yield.

-Number of shoots / m^2

-Regarding pure stands, White type of Bonavista bean was of the highest significant number of shoots/m^2 (22.25 shoots/m^2), whereas, Brown and Black types produced almost similar numbers of shoots/m^2 which was 16.75 and 13.25 shoots/m^2, respectively. So, the White type was of about 68% higher in number of shoots/m^2 as compared with the other two types (Brown and Black).

-Number of shoots/m^2 of Fodder cowpea types, (from the combined analysis) showed significant differences within the three tested indigenous native fodder cowpea types in their pure stands.

-The overall comparisons between each of the tested six types of indigenous native legumes in their pure stands, (combined analysis) showed that the Dotted type of Fodder cowpeas was the highest in number of shoots/m^2 as compared with any of the tested forage legume types. These results confirm that more number of shoots/m^2 of fodder cowpea types than B.bean types in general.

-It is recommended that either of the two mixtures Pearl millet (PM) +Dotted Fodder cowpea (DFC) and Pearl millet (PM) +Creamy Fodder cowpea (CFC) proved to be the best selected combinations regarding number of shoots/m^2. Whereas, increasing number of legume shoots in mixtures caused an increase of the nutrition value (TDN and DP) which up graded forage quality.

-Chemical constituents

-Crude protein (CP) content

-Brown and white of Bonavista bean types produced almost similar crude protein (CP) content which was 21.05 and 20.62 %, respectively without significant differences in between. Whereas, Black type was of the lowest significant crude protein (CP) content

(16.43 %), which was of about 28 % lower in CP content as compared with each to the other two Bonavista bean types.

-In comparison, crude protein (CP) content in pure Fodder cowpea types, (combined analysis) showed significant differences in this trait.

-Among the overall comparisons between all of the tested six types of indigenous native legumes, the combined analysis clarified that each of the Brown and White types of Bonavista bean was higher in crude protein (CP) content as compared with any of the tested fodder cowpea types

-Mixtures of Pearl millet (PM) +Dotted Fodder cowpea (DFC) and Pearl millet (PM) +Brown Fodder cowpea (BrFC) were of the best mixture combinations regarding CP content.

-Crude fiber (CF) content

-Brown type of Bonavista bean was of the highest significant crude fiber content (32.69%), whereas, White and Black Bonavista bean produced almost similar crude fiber content which was 29.25 and 30.50%, respectively. So, the Brown type was of about 12% higher in crude fiber content as compared with the other two types (White and Black).

-In Fodder cowpea types, crude fiber content (from the combined analysis) were of significant differences within the three tested types.

-Among the overall comparisons between all of the tested six types of indigenous native legumes, the combined analysis clarified that each of the Brown and Creamy types of fodder cowpea were higher in crude fiber content as compared with any of the tested Bonavista bean types.

-Mixtures of Pearl millet (PM) −Black Bonavista bean (BB) and Pearl millet (PM) +Creamy Fodder cowpea (CFC) were of the lowest combinations regarding crude fiber content.

- **Ash content**

-White type of Bonavista bean was of the highest significant ash content (12.50 %), whereas, Brown and Black Bonavista bean produced almost similar ash content which was 11.88 and 11.63 %, respectively. So, the White type was of about 8 % higher in ash content as compared with the other two types (Brown and Black).

-In comparing the ash content of pure stands of Fodder cowpea types, (combined analysis) exerted significant differences within each of the three tested F.cowpea types.

-The overall comparisons between all of the tested six types of native legumes, (combined analysis) clarified that each of the Creamy and Brown types of fodder cowpea was higher in ash content as compared with any of the tested Bonavista bean types.

-Mixtures of Pearl millet (PM) +Brown Fodder cowpea (BrFC) and Pearl millet (PM) +Black Bonavista bean (BB) were of the highest combinations regarding ash content.

- **Ether extract (EE) content**

-Brown type of Bonavista bean was of the highest significant content of ether extract (3.79 %); whereas, White and Black Bonavista bean produced similar ether extract content (3.65 %) for each of the two types.

-In comparing the ether extract content for pure stands of Fodder cowpea types, (combined analysis) showed significant differences within the three tested Fodder cowpea types.

-Regarding the overall comparisons between all of the tested six types in pure stands; (combined analysis) showed that each of the tested Fodder cowpea types was higher in ether extract content as compared with any of the tested Bonavista bean types.

-Mixtures of Pearl millet (PM) +Brown Bonavista bean (BrB) and Pearl millet (PM) +Brown Fodder cowpea (BrFC) were of the highest combinations regarding ether extract content.

-Nitrogen free extract (NFE) content

-Black type of Bonavista bean was of the highest significant nitrogen free extract (NFE)content (37.79 %), whereas, Brown and White types produced almost similar nitrogen free extract content which was 30.60 and 33.98 % respectively. So, the Black type was of about 23.5 % higher in nitrogen free extract content as compared with the other two types (Brown and White), where they exerted significant difference in between.

-In comparing the nitrogen free extract content in pure stands, Fodder cowpea types, (from combined analysis) exerted slight significant differences among the three tested F.cowpea types.

-Regarding the overall comparisons between all of the studied six types of native legumes, the combined analysis indicated that Black and White Bonavista bean types were higher in nitrogen free extract content as compared with any of the tested Fodder cowpea types.

-Mixtures of Pearl millet (PM) +White Bonavista bean (WB) and Pearl millet (PM) + Brown Bonavista bean (BrB) were of the best combinations regarding nitrogen free extract content.

-Nutritive value

A-Total digestible nutrients (TDN) content

-Regarding Bonavista bean, the White type was of the highest significant content of total digestible nutrients (60.30 %), which was of about 4 % higher in TDN content as compared with each to the other two Bonavista bean types (Brown & Black).

-Total digestible nutrients content in pure stands of Fodder cowpea types, (from combined analysis) were of significant differences within the three tested types.

-The overall comparisons between all of the tested six types of native legumes, (from combined analysis) showed that each of the White and Brown types of were higher in

total digestible nutrients as compared with any of the other tested fodder cowpea types in their pure stands.

-Mixtures of Pearl millet – Brown Fodder cowpea and Pearl millet + Dotted Fodder cowpea were of the highest combinations regarding its TDN content.

B-Digestible protein (DP) content

-Brown and white of Bonavista bean types produced almost similar digestible protein (DP) content which was 16.77 and 16.35 %, respectively without significant differences in between. Whereas, Black type was of the lowest significant digestible protein (DP) content (12.30 %), which was of about 26.6 % lower in DP content as compared with each to the other two Bonavista bean types (White and Brown).

-In comparison, digestible protein (DP) content in pure stands of Fodder cowpea types, (from combined analysis) were of significant differences within the three tested F.cowpea types.

-The overall comparisons between all of the tested six types of legumes, the combined analysis indicated that each of the Brown and White types of Bonavista bean was higher in digestible protein (DP) content as compared with any of the other tested fodder legumes.

-Mixtures of Pearl millet (PM) +Dotted Fodder cowpea (DFC) and Pearl millet (PM) +Brown Fodder cowpea (BrFC) were of the highest combinations regarding DP content.

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